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CASE WESTERN RESERVE UNIVERSITY

The University
Case Western Reserve University (http://case.edu) is one of the nation’s leading independent research universities, with programs that encompass the arts and sciences, engineering, the health sciences, law, management, and social work.

Brief History
Although its origins date to 1826, the university in its present form is the result of the 1967 federation of Case Institute of Technology and Western Reserve University. The two institutions had shared adjacent campuses since the late nineteenth century and were involved in cooperative efforts for many years. Western Reserve College was founded in 1826 in Hudson, Ohio, a town 26 miles southeast of Cleveland. The college took its name from that of the region, which at the time of the American Revolution, was known as the Western Reserve of Connecticut. In 1884, renamed Western Reserve University and boasting a medical school in addition to its undergraduate programs, the institution moved to the Cleveland site that later became known as University Circle. There it joined the Case School of Applied Science, founded in 1880 through the bequest of Leonard Case Jr., a leading benefactor and Cleveland civic leader. The name Case Institute of Technology was adopted in 1947 to reflect the institution’s growing stature in the sciences and engineering.

Mission and Vision

University Mission
Case Western Reserve University improves and enriches people's lives through research that capitalizes on the power of collaboration and education that dramatically engages our students.

We realize this goal through:

• Scholarship and creative endeavor that draws on all forms of inquiry.
• Learning that is active, creative and continuous.
• Promotion of an inclusive culture of global citizenship.

University Vision
We aim to be recognized internationally as an institution that imagines and influences the future.

Toward that end, we will:

• Support advancement of thriving disciplines as well as new areas of interdisciplinary excellence.
• Provide students with the knowledge, skills and experiences necessary to become leaders in a world characterized by rapid change and increasing interdependence.
• Nurture a community of exceptional scholars who are cooperative and collegial functioning in an atmosphere distinguished by support, mentoring and inclusion.
• Pursue distinctive opportunities to build on our special features including our relationships with world-class health care, cultural, educational, and scientific institutions in University Circle and across greater Cleveland.
Vice President for University Marketing and Communications and Senior Advisor to the President

John F. Sideras
Senior Vice President for Finance and Chief Financial Officer

Lynn T. Singer
Deputy Provost and Vice President for Academic Affairs

Louis W. Stark
Vice President for Student Affairs

Sue B. Workman
Vice President for University Technology and Chief Information Officer

Victoria Wright
Associate Vice President for University Planning and Administration

Deans

Jessica W. Berg
Dean of the School of Law

Kenneth B. Chance
Dean of the School of Dental Medicine

Pamela Bowes Davis
Dean of the School of Medicine, Senior Vice President for Medical Affairs

Grover C. Gilmore
Dean of the Jack, Joseph and Morton Mandel School of Applied Social Sciences

Mary E. Kerr
Dean of the Frances Payne Bolton School of Nursing

Manoj K. Malhotra
Dean of the Weatherhead School of Management

James McGuffin-Cawley
Interim Dean of the Case School of Engineering

Charles E. Rozek
Vice Provost and Dean of Graduate Studies

Michael P. Scharf
Dean of the School of Law

Cyrus C. Taylor
Dean of the College of Arts and Sciences

Jeffrey Wolowitz
Dean of Undergraduate Studies

Board of Trustees, Officers

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Chair of the Board of Trustees

Timothy J. Callahan
Vice Chair of the Board of Trustees

Thalia Dorwick, Ph.D.
Vice Chair of the Board of Trustees

Donald J. Richards
Vice Chair of the Board of Trustees

Accreditation

Case Western Reserve University is accredited at the institutional level by the Higher Learning Commission (http://www.ncahclic.org). In addition, many of Case’s individual programs are accredited by nationally recognized professional associations, including:

- AACSB International - Association to Advance Collegiate Schools of Business (accountancy and business)
- Computing Accreditation Commission of ABET, www.abet.org (http://www.abet.org), (BS degree program in computer science)
- Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org), (all BS degree programs in engineering, not including the engineering undesignated degree program)
- Accreditation Commission for Midwifery Education (ACME)
- Accreditation Council for Cooperative Education (cooperative education programs)
- American Bar Association (law)
- American Board of Genetic Counseling (genetic counseling)
- American Chemical Society (chemistry)
- American Dental Association (dentistry)
- American Medical Association and Association of American Medical Colleges, Liaison Committee on Medical Education (medicine)
- American Psychological Association (clinical psychology)
- American Speech-Language-Hearing Association (speech pathology)
- Commission on Accreditation for Dietetics Education, American Dietetic Association (didactic program in dietetics, dietetic internship)
- Commission on Accreditation of Allied Health Education Programs (anesthesiologist assistant)
- Commission on Collegiate Nursing Education (Bachelor of Science in Nursing, Master in Nursing, Master in Science of Nursing, Post Graduate APRN Certificate and Doctor of Nursing Practice programs)
- Council on Accreditation of Nurse Anesthesia Educational Programs
- Council on Education for Public Health (public health)
- Council on Social Work Education (applied social sciences)
- National Association of Schools of Music (music)
- Ohio Department of Education, Division of Teacher Education and Licensure (art education and music education)
- Teacher Education Accreditation Council (art education and music education)


For further information, contact the university’s Center for Institutional Research (http://www.cwru.edu/president/cir/cirhome.html).

Philosophy Statement on Educational Outcome Assessment

Case Western Reserve University commits to a comprehensive educational outcome assessment program, wherein we measure how our students have changed, what knowledge has been learned, and what competencies have been developed. Our educational outcome
assessment programs will not only provide information on how well we are achieving our objectives, but also identify what types of programs and experiences have the most powerful impacts. The ultimate goal is to incorporate continuous evaluation into the educational culture for the improvement of programs and for enhancing the distinctiveness of our university.

Education outcome assessments will be based on the core vision and mission of each school and the university as a whole. The faculty, empowered by adequate resources and support to carry out assessment activities, accepts that educational outcome assessment is a part of academic duties. Outcome assessment is embraced as a means that can lead to improvements in teaching and learning, plus provide evidence of teaching effectiveness for institutional purposes.

Cleveland

From a settlement that began centuries ago on the banks of the Cuyahoga River, Cleveland has grown into a metropolis of close to 3 million people. The heritage of this Great Lakes port includes industrial achievement as well as cultural and scientific advances. The Cleveland area is headquarters for many of the nation’s major corporations. The city is also a major banking center; the Fourth District Federal Reserve Bank, one of 12 in the nation, is located here.

Health care is another thriving Cleveland industry. Dozens of hospitals and medical centers are concentrated in the area. University Hospitals, the Cleveland Clinic, the MetroHealth Medical Center, and others have attained international recognition for outstanding patient care and contributions to medical research.

Greater Cleveland is dotted with shopping malls, theaters, and opportunities for sports and amusement. The latter include Lake Erie, the 17,000-acre Metropark system; professional baseball, football, and basketball teams; and facilities for softball, skiing, hiking, cycling, picnics, and other activities. More than 60 ethnic groups live in Cleveland; seasonal festivals continue traditions brought to the region from throughout the world.

University Circle

Case Western Reserve University is located in University Circle, a 550-acre concentration of more than 40 cultural, medical, educational, religious, and social service institutions located at the eastern edge of the city. In addition to Case Western Reserve University, which is the largest institution in University Circle, the community includes Severance Hall, home of the world-famous Cleveland Orchestra; the Cleveland Museum of Art, housing one of the nation’s finest collections; the Cleveland Institute of Music; the Cleveland Institute of Art; University Hospitals; the Western Reserve Historical Society; the Cleveland Botanical Garden; the Cleveland Museum of Natural History; and many others. All are within walking distance of the university.

University Circle attracts visitors worldwide and from throughout the region to its concerts, theater performances, athletic events, art shows, public lectures, exhibits, and restaurants. Housing, shopping, and recreational facilities are all located in the area.
CASE SCHOOL OF ENGINEERING

Engineering seeks to create new processes, products, methods, materials, or systems that impact and are beneficial to our society. To enable its graduates to lead the advancement of technology, the Case School of Engineering (http://engineering.case.edu) offers thirteen degree programs at the undergraduate level (eleven engineering degrees, plus the BS in computer science and the BS in data science and analytics). At the postgraduate level, the School of Engineering offers Master of Science programs and the Doctor of Philosophy for advanced, research-based study in engineering. The Case School of Engineering offers two specialized degrees at the master's level: a Master of Engineering specifically for practicing engineers, and an integrated Master of Engineering and Management jointly administered with the Weatherhead School of Management. The Case School of Engineering offers Graduate Certificates which provide an introductory graduate level understanding in the fields of Wireless Health, Wireless Health Product Development, Health Information Technology, Security in Computing, Mobility-Driven Computing and Wearable Computing. The Case School of Engineering also offers two dual-degrees at the graduate level jointly administered with the School of Medicine: a Doctor of Medicine/Master of Science and a Doctor of Medicine/Doctor of Philosophy. The faculty and students participate in a variety of research activities offered through the departments and the interdisciplinary research centers of the university.

At the core of its vision, the Case School of Engineering seeks to set the standards for excellence, innovation, and distinction in engineering education and research prominence.

Statement of Educational Philosophy

The Case School of Engineering prepares and challenges its students to take positions of leadership in the professions of engineering and computer science. Recognizing the increasing role of technology in virtually every facet of our society, it is vital that engineering students have access to progressive and cutting-edge programs stressing five areas of excellence:

- Mastery of fundamentals
- Creativity
- Societal awareness
- Leadership skills
- Professionalism

Emphasizing these core values helps ensure that tomorrow's graduates are valued and contributing members of our global society and that they will carry out the tradition of engineering leadership established by our alumni.

The undergraduate program aims to create life-long learners by emphasizing engineering fundamentals based on mathematics, physical, and natural sciences. Curricular programs are infused with engineering innovation, professionalism (including engineering ethics and the role of engineering in society), professional communications, and multidisciplinary experiences to encourage and develop leadership skills. To encourage societal awareness, students are exposed to and have the opportunity for in-depth study in the humanities, social sciences, and business aspects of engineering. Undergraduate students are encouraged to develop as professionals. Opportunities include the Cooperative Education Program, on-campus research activities, and participation in the student chapters of professional societies. Graduates are prepared to enter the workforce and be strong contributors as practicing engineers, or continue for advanced study in engineering.

At the graduate level, the Case School of Engineering combines advanced classroom study with a rigorous independent research experience leading to significant results appropriate for publication in archival journals and/or presentation at leading technical conferences. Scientific integrity, engineering ethics, and communication skills are emphasized throughout the program.

Brief History

The Case School of Engineering was established on July 1, 1992, by an action of the Board of Trustees of Case Western Reserve University as a professional school dedicated to serving society and meeting the needs of industry, government and academia through programs of teaching and research.

The Case School of Engineering continues the tradition of rigorous programs based on fundamental principles of mathematics, science and engineering that have been the hallmark of its two predecessors, the Case School of Applied Science (1880) and the Case Institute of Technology (1947). The formation of the Case School of Engineering is a re-commitment to the obligations of the gift of Leonard Case, Jr., to serve the citizens of Northern Ohio. The Case School of Engineering has been a leader in many educational programs, being the first engineering school to offer undergraduate programs in computer engineering, biomedical engineering, polymer engineering, and systems and control engineering.

Accreditation

The following Bachelor of Science programs are accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org):

- Aerospace Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Engineering Physics
- Materials Science and Engineering
- Mechanical Engineering
- Polymer Science and Engineering
- Systems and Control Engineering

The following Bachelor of Science program is accredited by the Computing Accreditation Commission of ABET, www.abet.org (http://www.abet.org):

- Computer Science
### Enrollment Statistics by Degree Program (Fall 2012 through Fall 2016).

Data reflects sophomore, junior and senior declared Majors.

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### Graduation Statistics by Degree Program (AY 2012-13 through AY 2016-17)

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### Degrees Granted

**Bachelor of Science in Computer Science** (p. 63)

**Bachelor of Arts in Computer Science** (p. 63) (granted by the College of Arts and Sciences and administered by the Department of Electrical Engineering and Computer Science)

**Bachelor of Science in Data Science and Analytics**

**Bachelor of Science in Engineering** with the following major field designations:

- Aerospace Engineering (p. 150)
- Biomedical Engineering (p. 21)
- Chemical Engineering (p. 44)
- Civil Engineering (p. 54)
- Computer Engineering (p. 63)
- Electrical Engineering (p. 63)
- Engineering Physics (p. 110)
- Materials Science and Engineering (p. 129)
- Mechanical Engineering (p. 150)
- Polymer Science and Engineering (p. 113)
- Systems and Control Engineering (p. 63)

**Bachelor of Science in Engineering (Undesignated)** (p. 169) (for programs that emphasize interdisciplinary areas or for programs that include some emphasis on non-technical fields)

**Bachelor of Science in Engineering/Master of Engineering**

**Bachelor of Science in Engineering/Master of Science**

- Aerospace Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Computing and Information Science
- Electrical Engineering
- Materials Science and Engineering
- Mechanical Engineering
• Polymer Science and Engineering/Macromolecular Science and Engineering
• Systems and Control Engineering

Master of Engineering (practice-oriented program)

Master of Engineering and Management

Master of Science with the following major field designations:

• Aerospace Engineering (p. 154)
• Biomedical Engineering (p. 27)
• Chemical Engineering (p. 48)
• Civil Engineering (p. 58)
• Computer Engineering (p. 79)
• Computing and Information Science (p. 79)
• Electrical Engineering (p. 79)
• Macromolecular Science and Engineering (p. 117)
• Materials Science and Engineering (p. 134)
• Mechanical Engineering (p. 154)
• Systems and Control Engineering (p. 79)

Master of Science with the following major field designations and optional track:

• Biomedical Engineering:
  - Translational Health Technology
  - Wireless Health
• Electrical Engineering:
  - Wearable Computing
  - Wireless Health
• Macromolecular Science and Engineering:
  - Fire Science and Engineering
• Mechanical Engineering:
  - Fire Science and Engineering

Master of Science (Undesignated) (p. 169)

Doctor of Medicine/Master of Science

• Biomedical Engineering

Doctor of Philosophy with the following major field designations:

• Aerospace Engineering
• Biomedical Engineering
• Chemical Engineering
• Civil Engineering
• Computer Engineering
• Computing and Information Science
• Electrical Engineering
• Macromolecular Science and Engineering
• Materials Science and Engineering
• Mechanical Engineering
• Systems and Control Engineering

Doctor of Medicine/Doctor of Philosophy with the following major field designations:

• Mechanical Engineering

Engineering Minors

Students enrolled in other majors may elect to pursue a minor. The minor program advisor’s approval is required. The successful completion of a minor will be indicated on a student’s transcript. For a full list of engineering and university minors, go to the Office of Undergraduate Studies (https://case.edu/ugstudies/programs-requirements/majors-minors) website.

List of Minors

Engineering Minors

• Biomedical Engineering
• Chemical Engineering
• Civil Engineering
• Computer Engineering
• Computer Science
• Electrical Engineering
• Materials Science and Engineering
• Polymer Science and Engineering
• Systems and Control Engineering

University Minors

• Artificial Intelligence (p. 63)
• Applied Data Science (p. 129)
• Computer Gaming (p. 63)
• Mechanical Design and Manufacturing (p. 150)

Bachelor of Science in Engineering

In addition to the major department requirements, each engineering undergraduate degree program includes the Engineering Core (Engineering General Education Requirements), which provides a foundation in mathematics and sciences as well as aspects of engineering fundamentals for programs in engineering. The Engineering Core is also designed to develop communication skills and to provide a body of work in the humanities and social sciences. Requirements of the Engineering Core can be found in the Undergraduate Studies (p. 1072) section of this bulletin.

Details of the specific curricular requirements for the undergraduate majors are described in the respective departmental descriptions. Details of the requirements of the undesignated engineering undergraduate degree are described under the Engineering Undesignated description.

Bachelor of Science in Engineering/Master of Science

The integrated B.S./M.S. program is intended for highly motivated and qualified undergraduate students who wish to pursue an advanced degree. Students admitted to the program may, in the senior year, take up to nine credits of graduate courses that will count toward both B.S. and M.S. requirements.
Master of Science

Students who have received a B.S. degree in engineering or computer science from the Case School of Engineering, and who are accepted for admission into the Master of Engineering (M.E.) degree program within a period of 24 months after graduation, are entitled to transfer up to 6 credit hours of course work from their B.S. degree to their M.E. degree program.

The courses to be considered for transfer should be specified at the time of application to the M.E. program, and require approval by the director of the Master of Engineering Program and the Dean of Engineering. Once approved, a request for an internal transfer of credit will be sent to the Registrar, and these courses will be included in the student’s planned program of study for the M.E. degree.

Master of Engineering

The Master of Engineering Program is a graduate degree program that targets engineers currently employed in industry. The objective of this program is to provide engineers in industry as well as business, management, and teamwork skills. The program differs from a traditional Master of Science degree in engineering by combining core courses that focus on the engineering-business environment and technical elective courses that concentrate on contemporary industrial practice rather than on research.

The Master of Engineering Program prepares students to enhance their role as corporate leaders and provides an environment in which practicing engineering professionals can address the increasingly wide range of technical, management, financial and interpersonal skills demanded by an ever-expanding and diverse global industry base.

The Master of Engineering Program requires 30 credit hours of course work that include 18 credit hours of core courses and 12 credit hours of technical electives that are chosen from focus areas (see below). It is possible to complete the Master of Engineering degree program within a two-year (six semester), part-time, program of study, although most students choose to complete the program over a seven-nine semester period.

The program is composed of both online and traditional on-campus classes, with core courses aimed at equipping participants with knowledge on how engineering is practiced in contemporary industry, and technical electives that provide depth in a chosen specialty area. All core courses are provided in an exclusively online format. The technical elective sequences for Biomedical Engineering (EBME), Engineering Innovation, Management and Leadership (EIML), Mechanical Engineering (EMAE) and Systems & Control Engineering (SCS) are also in an online format. Other technical elective courses are held on campus in the late afternoon or evening hours, and in an online distance-learning format to minimize disruption at the workplace and home. Because the program makes extensive use of computers, participants need to have access to computer facilities.

The Master of Engineering degree is also available exclusively online. Visit online-engineering.case.edu/masters/ for more details.

Curriculum

The program consists of a set of six core courses and a four course technical elective sequence (a total of 30 credit hours are required). The core courses provide a common base of study and experience with problems, issues, and challenges in the engineering business environment. The technical course sequence provides an opportunity to update disciplinary engineering skills and to broaden interdisciplinary skills. Up to six transfer credits may be approved for graduate-level courses taken at Case Western Reserve or another accredited university.

Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPOM 400</td>
<td>Leadership and Interpersonal Skills</td>
<td>3</td>
</tr>
<tr>
<td>EPOM 401</td>
<td>Introduction to Business for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>EPOM 403</td>
<td>Product and Process Design and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Implementation</td>
<td></td>
</tr>
<tr>
<td>EPOM 405</td>
<td>Applied Engineering Statistics</td>
<td>3</td>
</tr>
<tr>
<td>EPOM 407</td>
<td>Engineering Economics and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Financial Analysis</td>
<td></td>
</tr>
<tr>
<td>EPOM 409</td>
<td>Master of Engineering Capstone Project</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units: 18

Technical Electives

Four courses are chosen from the technical concentration areas below. For detailed course offerings in these areas, please refer to the Master of Engineering (http://www.engineering.case.edu/meng) program information on the Case School of Engineering website.

- Biomedical Engineering
- Chemical Engineering
- Computer Engineering
- Infrastructure Engineering
- Macromolecular Science and Engineering
- Materials Processing and Synthesis
- Mechanical Engineering
- Robotics and Control
- Software Engineering
- Signal Processing and Communications

Master of Engineering and Management

The Master of Engineering and Management (MEM) program provides the business context and leadership skills needed to uniquely position graduates for rapid advancement in technology based organizations. This interdisciplinary, joint degree program combines the problem solving rigor of the Case School of Engineering and the organizational insights of the Weatherhead School of Management in a 12 month, lock-step program focused on delivering the high impact talent companies are actively seeking. This program evolved after years of research and interviews with over 110 professionals and twenty-eight corporations across the U.S. Students can enter this program after their junior year or upon graduation.

The Program

The program includes 42 credit hours of graded course work. The 11-course core sequence makes up 33 of the required credit hours. For the remaining 9 credit hours, students can choose from any 400 level engineering course for which prerequisites are met or from the list below. The program prepares participants to function as technical leaders with a unique blend of broadened engineering and management skills which can have strategic impact on an organization’s bottom line.
## Required Core Courses (33 credit hours)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIME 400</td>
<td>Leadership Assessment and Development (LEAD)</td>
<td>3</td>
</tr>
<tr>
<td>IIME 405</td>
<td>Project Management</td>
<td>3</td>
</tr>
<tr>
<td>IIME 410</td>
<td>Accounting, Finance, and Engineering Economics</td>
<td>3</td>
</tr>
<tr>
<td>IIME 415</td>
<td>Materials and Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>IIME 420</td>
<td>Information, Design and Systems</td>
<td>3</td>
</tr>
<tr>
<td>IIME 425</td>
<td>Understanding People and Change in Organizations</td>
<td>3</td>
</tr>
<tr>
<td>IIME 430A</td>
<td>Product and Process Design, Development, and Delivery I</td>
<td>3</td>
</tr>
<tr>
<td>IIME 430B</td>
<td>Product and Process Design, Development, and Delivery II</td>
<td>3</td>
</tr>
<tr>
<td>IIME 435</td>
<td>Enterprise Resource Planning in the Supply Chain</td>
<td>3</td>
</tr>
<tr>
<td>IIME 440</td>
<td>Six Sigma and Quality Management</td>
<td>3</td>
</tr>
<tr>
<td>IIME 450</td>
<td>Technology Entrepreneurship (Fall 2017)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Units**: 33

## Elective Courses (9 credit hours)

A total of 9 credit hours, typically 3 courses, may be chosen from 400 level engineering courses or from the approved courses listed below.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIME 446</td>
<td>Models of Health Care Systems (*)</td>
</tr>
<tr>
<td>IIME 447</td>
<td>Regulatory Affairs for the Biosciences (*)</td>
</tr>
<tr>
<td>IIME 470</td>
<td>Independent Projects</td>
</tr>
<tr>
<td>IIME 472</td>
<td>BioDesign</td>
</tr>
<tr>
<td>IIME 473</td>
<td>Fundamentals of Clinical Information Systems</td>
</tr>
<tr>
<td>IIME 475</td>
<td>Technology Marketing Strategy</td>
</tr>
<tr>
<td>BAFI 444</td>
<td>Entrepreneurial Finance</td>
</tr>
<tr>
<td>DSCI 451</td>
<td>Exploratory Data Science</td>
</tr>
<tr>
<td>EBME 440</td>
<td>Translational Research for Biomedical Engineers</td>
</tr>
<tr>
<td>EECS 474</td>
<td>Advanced Control and Energy Systems</td>
</tr>
<tr>
<td>ENTP 428</td>
<td>Entrepreneurship and Innovation</td>
</tr>
<tr>
<td>HSMC 412</td>
<td>Lean Services Operations</td>
</tr>
<tr>
<td>HSMC 421</td>
<td>Health Economics and Strategy</td>
</tr>
<tr>
<td>MGMT 467</td>
<td>Commercialization and Intellectual Property Management</td>
</tr>
<tr>
<td>MKMR 408</td>
<td>Marketing Metrics</td>
</tr>
<tr>
<td>OPMT 475</td>
<td>Supply Chain Logistics</td>
</tr>
<tr>
<td>ORBH 480</td>
<td>Executive Leadership</td>
</tr>
<tr>
<td>ORBH 491</td>
<td>Leadership in Diversity and Inclusion: Towards a Globally Inclusive Workplace</td>
</tr>
</tbody>
</table>

*courses are 1.5 credit hours and are generally taken together in one semester.

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## Master of Science

Recognizing the different needs and objectives of resident and non-resident graduate students pursuing the master's degree, two different plans are offered. In both plans, transfer of credit from another university is limited to six hours of graduate-level courses, taken in excess of the requirements for an undergraduate degree, approved by the student's advisor, the department chair, and the dean of graduate studies.

All Master of Science degree programs require the submission of a Planned Program of Study via the Student Information System where it will be routed for appropriate approvals. Students must submit an approved program of study by the end of the second semester. A revised program of study must be submitted via the Student Information System when any change in the original plan occurs.

### Master's Thesis Plan (Plan A)

Minimum requirements for the degree of Master of Science in a major field under this plan are:

1. Completion of 18 hours of graduate course work at the 400 level or higher. The courses must be approved by the department offering the degree.

2. Completion of nine hours of thesis work culminating in a thesis examination given by at least three professors, plus approval by the chair of the department offering the degree. A student with research experience equivalent to a thesis may petition the Graduate Committee of the Case School of Engineering for substitution of nine hours of course work for the thesis requirement. In this case, the thesis examination above is replaced by a similar examination covering the submitted research work and publications.

### Master's Comprehensive Plan (Plan B)

Students may pursue either a project or non-project track under this option. Minimum requirements for the degree of Master of Science in a major field under this plan are one of the following:

#### Project track

Completion of 27 hours of graduate course work at the 400 level or higher, including three to six hours of Special Problems. Special Problems course work must consist of an engineering project approved by the chair of the department offering the degree, and may be carried out at the student's place of employment with nominal supervision by a faculty advisor or in the school's laboratories under direct supervision. The project must culminate in a written report and examination by at least three professors plus approval by the chair of the department offering the degree. The Special Problems course may be waived for students who have had industrial design or research experience and who submit sufficient evidence of this experience in the form of a publication or internal report. For these students, a minimum of 27 hours of course work and the final oral examination covering the submitted publications or reports as well as related course material will be required for the master's degree.

#### Non-project track

Completion of 27 hours of graduate course work at the 400 level or higher, not including Special Problems course work, must, also, pass satisfactorily a comprehensive examination to be administered by the department or curricular program committee. The examination may be written or oral, or both. A student must be registered during the semester in which any part of the comprehensive examination is taken. If not registered for other courses, the student will be required to register for
one semester hour of EXAM 600 Master’s Comprehensive Exam before taking the examination.

Distance Education
The Case School of Engineering offers five graduate degree programs exclusively online, giving working engineers the opportunity to advance their careers from anywhere.

Specialized online degrees (http://online-engineering.case.edu) are available in the following disciplines:

- Master of Engineering (https://online-engineering.case.edu/masters)
- Master of Science in Biomedical Engineering (https://online-engineering.case.edu/biomedical)
- Master of Science in Mechanical Engineering (https://online-engineering.case.edu/mechanical)
- Master of Science in Civil Engineering (https://online-engineering.case.edu/civil)
- Master of Science in Systems & Control Engineering (https://online-engineering.case.edu/systems)

The programs are designed for working professionals and can be completed in fewer than two years. All courses are taught by the same world-renowned faculty who teach graduate students on campus. With the same in-depth, rigorous content delivered in a convenient online format, students who participate in the online programs receive the same robust education and training as traditional on-campus master’s students.

Learn more and apply. (https://online-engineering.case.edu)

Additional Distance Learning Opportunities
In addition to the online-exclusive programs, the Case School of Engineering offers select classes in its campus-based graduate degree programs in a convenient online format designed for students who need additional flexibility.

Learn more about available online courses. (http://engineering.case.edu/current-students/distance-learning/registration)

Doctor of Medicine/Master of Science (http://casemed.case.edu/admissions/education/dual_programs.cfm?program_id=11)

Medicine is undergoing a transformation based on the rapid advances in science and technology that are combining to produce more accurate diagnoses, more effective treatments with fewer side effects, and improved ability to prevent disease. The goal of the MD/MS in Engineering is to prepare medical graduates to be leaders in the development and clinical deployment of this technology and to partner with others in technology based translational research teams. For further information, see the MD/MS Program in the Biomedical Engineering graduate section of this bulletin (p. 27). Interested students should apply through the biomedical engineering department.

The student’s PhD program should be designed to prepare him or her for a lifetime of creative activity in research and in professional engineering practice. This may be coupled with a teaching career. The mastery of a significant field of knowledge required to accomplish this purpose is demonstrated by an original contribution to knowledge embodied in a thesis and by satisfactory completion of a comprehensive course program which is intensive in a specific area of study and includes work in other areas related to, but not identical with, the major field. The necessity for breadth as well as depth in the student’s education cannot be overemphasized. To this end, any engineering department may add additional requirements or constraints to ensure depth and breadth appropriate to its field.

No student may be admitted to candidacy for the PhD degree before approval of his or her Planned Program of Study via the Student Information System. After this approval has been obtained, it is the responsibility of the student’s department to notify the dean of graduate studies of his or her admission to candidacy after the student has fulfilled any additional department requirements. Minimal requirements in addition to the university requirements are:

1. The minimum course requirement beyond the BS level is 36 credit hours of courses taken for credit, at least 18 hours of which must be taken at Case Western Reserve University. The following courses taken for credit will be acceptable for a PhD program of study:
   i. All 400-, 500-, and 600-level courses
   ii. Approved graduate-level courses taken at other institutions
2. A minimum depth in basic science equivalent to six semester hours (for credit) is required. This requirement is to be satisfied by courses that have been previously approved by the faculty of the department in which the student is enrolled.
3. The requirement for breadth is normally satisfied by a minimum of 12 semester hours of courses (for credit) outside the student’s major area of concentration as defined by the student’s department and does not include courses taken to fulfill the basic science requirement.
4. A minimum of three teaching experiences as defined by the student’s department. All programs of study must include departmental 400T, 500T, and 600T courses to reflect this requirement. All students fulfilling teaching duties must complete UNIV 400A or UNIV 400B.
5. The minimum requirement for research is satisfied by at least 18 hours of thesis (701) credits.
6. A cumulative quality-point average of 3.0 or above in all courses taken for credit as a graduate student at Case Western Reserve University (excluding grades in thesis research and grades of R) is required for the award of the doctoral degree.

Qualifying Examination
The student must pass a qualifying examination relevant to his or her area of study as designated by the curricular department with which he or she is affiliated. For students who obtain the MS degree from Case Western Reserve University, the qualifying examination should be taken preferably before the end of the student’s fourth semester of graduate study but no later than the end of the fifth semester at the university. For students entering with the master’s degree, the examination should be taken no later than the end of the third semester at the university.

Planned Program of Study
Each student is required to submit a Planned Program of Study, detailing his or her course work, thesis schedule, and qualifying examination schedule and indicating that all the minimum requirements of the
university and the faculty of the Case School of Engineering are satisfied. This Planned Program of Study must be submitted via the Student Information System for approval before registering for the last 18 credits hours of the program.

If the student is pursuing the PhD degree without acquiring the MS degree, a petition to waive the requirement of the MS degree should be approved by the departmental advisor and the chair and submitted to the dean of graduate studies. All required courses taken at the university beyond the BS degree should be shown on the Planned Program of Study with the grade if completed. If the requirements are to be fulfilled in ways other than the standard described above, a memorandum requesting approval should be submitted to the dean of graduate studies.

The Planned Program of Study must be submitted within one semester after passing the qualifying examination.

Doctor of Medicine/Doctor of Philosophy (http://mstp.case.edu)

Students with outstanding qualifications may apply to the MD/PhD program. Students interested in obtaining a combined MD/PhD, with an emphasis on basic research in biomedical engineering or mechanical engineering, are strongly encouraged to explore the Medical Scientist Training Program (MSTP), administered by the School of Medicine. For further information, please see the Medical Scientist Training Program (MSTP) in the School of Medicine section of this bulletin. Interested students should apply through the MSTP office in the Medical School.

Graduate Certificates

Graduate Certificates are discipline independent and intended to enable knowledgeable entry into the field of study. They are prescribed 3-course, 9-credit subsets of our MS degree offerings

- **Wearable Computing**
- **Wireless Health**

For more details, please refer to the Graduate Certificate (http://engineering.case.edu/sandiego/gc) information on the Case School of Engineering - San Diego website.

Interdisciplinary research centers act as intensive incubators for students and faculty doing research and studying applications in specialized areas. Research centers and research programs at the Case School of Engineering have been organized to pursue cutting-edge research in collaboration with industrial and government partners. The transfer of technology to industry is emphasized in all the centers.

The educational programs of these centers encompass the training of graduate students in advanced methods and strategies, thus preparing them to become important contributors to industry after graduation; the involvement of undergraduates in research; the presentation of seminars that are open to interested members of the community; and outreach to public schools to keep teachers abreast of scientific advances and to kindle the interest of students in seeking careers in engineering.

Advanced Manufacturing and Mechanical Reliability Center (AMMRC)

White Building (7205)
Phone: 216.368.4234
John J. Lewandowski, Director
john.lewandowski@case.edu

The Advanced Manufacturing and Mechanical Reliability Center (AMMRC) was established to provide advanced manufacturing (e.g. deformation processing, extrusion, forming, etc.) and mechanical characterization (e.g. mechanical testing, reliability testing, fatigue, etc.) expertise to the CWRU campus, medical, industrial, legal, outside university, and government laboratory communities. The center, housed in the Charles M. White Metallurgy building, currently maintains equipment valued in excess of $4.5M and has been accessed by the local, national, and international communities. The CWRU campus community can access the facility via the use of a valid CWRU university account number that will be charged at an internal rate for machine time, including set up and any technician time involved. Long term testing can be provided at pro-rated charges in consultation with the center directors.

Arrangements can be made to train users on the equipment and reserve time for equipment use by contacting the center co-director. Outside (i.e. non-CWRU) users can access the facility via a number of different mechanisms by contacting the center director.

In general, the center is capable of mechanically evaluating and deformation processing materials that range in size scale from the micrometer range up through bulk quantities. This unique facility enables mechanical characterization at loading rates as low as one micrometer/hour (i.e. rate of fingernail growth!) up through impact (e.g. 3-4 meters/sec) at temperatures ranging from -196C (i.e. liquid nitrogen) up to 1400C. Hot microhardness testing up to 1000C is available. Monotonic as well as cyclic fatigue testing is possible in addition to evaluations of mechanical behavior and processing with superimposed pressures up to 2 GPa. Novel high-rate and multiple-deformation sequence forging simulations are possible with the use of a multi-actuator forging simulator, in addition to sheet metal forming experimentation with independent control of forming rate and blank hold down force. Hot extrusion is also possible at temperatures up to 900C on 0.5” diameter billets. Materials systems that have been investigated span the range of organic and inorganic materials, including metals, ceramics, polymers, composites, electronic materials, and biomedical materials systems. Descriptions of specific equipment and capabilities are provided with the website link.

Advanced Platform Technology (APT) Center

Louis Stokes Cleveland Veterans Affairs Medical Center
10701 East Boulevard, Mail Stop 151 W/APT
Cleveland, Ohio 44106
Phone: 216.707.6421 Fax: 216.707.6420
Ronald J. Triolo, Executive Director
ronald.triolo@case.edu

The Advanced Platform Technology (APT) Center at the Louis Stokes Cleveland Veterans Affairs Medical Center (LSCVAMC) is one of 13 designated Centers in the Rehabilitation Research and Development Service. The APT Center focuses on serving veterans with sensorimotor dysfunction, cognitive impairment, or limb loss using cutting edge technologies and rehabilitation techniques, translating them from proof of concept to viable clinical options. Advances in material science,
microfabrication and microsystem design, neural engineering, mechanics and communications are captured and integrated for applications in prosthetics/orthotics, neural interfacing, wireless health monitoring and maintenance and all forms of enabling and emerging technologies. The APT Center is able to provide or facilitate access to the following resources:

1. Neural modeling and analysis of interface designs
2. Polymer and bioactive material development
3. Microelectromechanical (MEMS) systems design and fabrication
4. 3-D and laser printing/prototyping, mechanical testing and dynamic simulation
5. Pre-clinical in vitro and in vivo verification of device performance
6. Circuit, sensor and software design and fabrication
7. System validation and design control documentation
8. Professional engineering support and project management
9. Administrative support for intellectual property protection, regulatory affairs, and quality systems

The APT Center was established in 2005 as a collaboration between the LSCVAMC and Case Western Reserve University (CWRU). Over 50 Engineers and Clinician Scientists at the LSCVAMC, CWRU, Cleveland Clinic, University Hospitals, Cleveland State University, Kent State University, University of Michigan, and Cornell University are affiliated with the APT Center and contribute to its mission.

Case Metal Processing Laboratory (CMPL)

113 White Building
Phone: 216.368.5070 Fax 216.368.3209
Matthew A. Willard, Faculty Director
matthew.willard@case.edu

The CMPL houses state-of-the-art, melting and casting capabilities for a wide range of ferrous and non-ferrous alloys. The facility is a unique combination of laboratory and industrial scale equipment. Research projects with federal and industrial support are carried out by teams of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification of faculty, graduate and undergraduate students. Manufacturing of castings are from Computer Aided Design, flow and solidification...

Center for Advanced Polymer Processing (CAPP)

Kent Hale Smith Building, 3rd floor
Phone: 216.368.6372 Fax 216.543.4202
Joao Maia, Director
joao.maia@case.edu

CAPP is a state-of-the-art center for advanced polymer blending and compounding and reactive extrusion at CWRU able to perform basic research and applied research and development in support of the Ohio and US plastics industry. The main tools of CAPP are:

- State-of-the-art sensors that allow multiple rheological, physical, chemical and morphological quantities to be measured along the screw axis of twin-screw extruders;
- Advanced multi-scale computational simulation capabilities to build physical-chemical-structural models of polymer systems under flow in realistic polymer transformation processes;
- Integration of on-line sensors and multi-scale softwares to develop new advanced and functional multiphase complex materials or optimize the performance of existing ones.

Center for Biomaterials

202 Wickenden Building (7207)
William Marx, Interim Director
william.marx@case.edu

Anirban Sen Gupta, Associate Director
Phone: 216.368.4564
anirban.sengupta@case.edu

The Center for Biomaterials carries out research and development projects to investigate new biomaterials, tissue engineered materials, and targeted drug delivery systems for use in cardiovascular applications and implants. The Center for Biomaterials also provides researchers access to shared use facilities, which includes high resolution microscopy such as AFM, molecular spectroscopies, surface analysis, and polymer and peptide synthesis capabilities. The chemical and mechanical interface between the biomaterial and the host tissue are the focus of major study, with the goals being to improve biologic function and biocompatibility in the response of the human body to implants. Current projects include investigation of thrombosis (blood clotting) and infection mechanisms due to cardiovascular prosthesis, biomimetic design of novel biomaterials for cardiovascular and neural implants; and cardiovascular and neural tissue engineering based on biomimetic designs. Studies at the cell and molecular level assist our understanding of the underlying mechanisms so that novel biomedical materials may be designed, prepared, and characterized.

Center for Computational Imaging and Personalized Diagnostics (CCIPD)

Wickenden Building Room 523
Phone: 216.368.8519
Anant Madabhushi, Director
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The Center of Computational Imaging and Personalized Diagnostics at Case Western Reserve University is involved in various different aspects of developing, evaluating and applying novel quantitative image analysis, computer vision, signal processing, segmentation, multi-modal co-registration tools, pattern recognition, and machine learning tools for disease diagnosis, prognosis, and theragnosis in the context of breast, prostate, lung, head and neck, and brain tumors. The group is also exploring the utility of these methods in studying correlations of disease markers across multiple length scales, modalities, and functionalities - from gene and protein expression to spectroscopy to digital pathology and to multi-parametric MRI and CT.

**Center for the Evaluation of Implant Performance (CEIP)**

Wearn Building Room 511  
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Clare Rimnac, Director  
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The mission of the Center for the Evaluation of Implant Performance is to pursue engineering and scientific analysis of retrieved joint reconstruction devices and to evaluate the performance of implants during patient use. This mission is achieved through IRB-approved collection, maintenance, and protection of clinical and radiographic information and total joint replacement components obtained at revision or removal surgery. The goal is to advance the science of joint replacement durability and improved performance for better patient outcomes through improvements in implant materials and design. To this end, the Center for the Evaluation of Implant Performance works in partnership with the Center for Joint Replacement and Restoration at University Hospitals Case Medical Center.

**Center for Layered Polymeric Systems (CLiPS)**

NSF Science and Technology Center  
420 Kent Hale Smith Building (7202)  
Phone: 216.368.4203 Fax 216.368.6329  
Eric Baer, Director  
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CLiPS researchers and educators work together to accomplish the Center’s mission of advancing the nation’s science and technology agenda through development of new materials systems and for educating a diverse American workforce through interdisciplinary education programs.

CLiPS research focuses on exploration of multilayered polymeric systems at the micro- and nano-layer levels and has revealed unique properties and capabilities that are different, and often not predicted, from systems involving the same materials on a larger scale. Technology refined within CLiPS allows the production of films and membranes composed of hundreds or thousands of layers. These extremely thin layers promote interactions approaching the molecular level between the materials used in the process.

The research activities are organized into five platforms to exploit the microlayer and nanolayer structures: (1) Rheology and New Processing focuses on integrating rheology into the multilayering process, and will explore combinations of rheologically dissimilar materials to create new polymer-based structures; (2) advanced Membranes and Transport Phenomena that exploit the layered hierarchy to achieve unique transport properties; (3) novel Optic and Electronic Systems based on the advanced layered materials; (4) Science and Technology Initiatives that probe a fundamental understanding and explore new opportunities for the layered structures; and (5) Templated Interfaces and Reactions looking at polymer materials that are amenable to patterning and ordering, and exhibit a specific field response. Of particular interest are polymer systems and nanomaterials that are appropriate for biological applications.

CLiPS was established in 2006 with funding by the National Science Foundation as a Science and Technology Center. It is the first NSF STC ever to be established at Case Western Reserve University. CLiPS is a national center involving close partnership with the University of Texas, Fisk University, the University of Southern Mississippi, and the Naval Research Laboratory, and an important educational partnership with the Cleveland Metropolitan School District.

**Center for Dielectrics and Energy Storage (CDES)**

312 Kent Hale Smith Building  
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Ixz121@case.edu

CDES mission is to discover, develop, and translate novel dielectric technologies for energy storage and capacitor applications. Researching high energy density, high temperature, and low loss dielectric film capacitors, we integrate these innovations with storage devices, hybrid electric vehicles, multi-megawatt power conditioning, pulsed power, and high energy physics applications. Originating from the Center for Layered Polymeric Systems (CLiPS), a National Science Foundation Science and Technology Center focusing on research, innovation, and education through a unique multilayer film technology, CDES extends this technology into new energy frontiers.

CDES has access to state-of-the-art equipment, which includes process equipment for fabricating, stretching, and testing dielectric films, including:

- Novocontrol Concept 80 Broadband Dielectrics Spectrometer
- Radiant Premier II Ferroelectric Tester
- Bruckner Kato IV Biaxial Stretcher

In addition to research, CDES plays a significant role in educating undergraduate students, graduate students, and post-doctoral associates to work in advanced energy material fields.

**Cleveland Functional Electrical Stimulation Center (FES)**

10701 East Boulevard, Cleveland, Ohio 44106  
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Robert J. Kirsch, Executive Director  
info@FEScenter.org

Functional Electrical Stimulation (FES) is the application of electrical currents to either generate or suppress activity in the nervous system. FES can produce and control the movement of otherwise paralyzed limbs, for standing and hand grasp; activate visceral bodily functions, such as micturition; create perceptions such as skin sensibility; arrest undesired
activity, such as pain or spasm; facilitate natural recovery; and accelerate motor relearning. FES is particularly powerful and clinically relevant, since many people with neurological disabilities retain the capacity for neural conduction and are thus amenable to this intervention. The center focuses its activities in four major areas:

- Fundamental studies to discover new knowledge
- Enabling technologies for clinical application or the discovery of knowledge
- Clinical research that applies this knowledge and technology to individuals with neurological dysfunction
- Transfer of knowledge and technology to the clinical community and to industry.

The FES Center was established as a VA RR&D Center of Excellence in 1991 and is based at the Louis Stokes Cleveland VAMC (VAMC). The center is a consortium with four institutional partners: VAMC, Case Western Reserve University (CWRU), the MetroHealth Medical Center (MHMC), and University Hospitals of Cleveland (UHC). The center accomplishes its mission by integrating and facilitating the efforts of scientists, engineers, and clinicians through common goals and directions in the major clinical areas, and by providing mechanisms to accomplish these goals across the institutional partners.

Control and Energy Systems Center (CESC)

Olin Building, 6th Floor
Phone: 216.368.5122
Mario Garcia-Sanz, Director
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Website: http://cesc.case.edu

With an interdisciplinary and concurrent engineering approach, the Control and Energy Systems Center (CESC) focuses on bridging the gap between fundamental research and applied industrial projects in Advanced Control and Systems Engineering, with special emphasis in energy innovation, wind energy, power systems, water treatment plants, sustainability, spacecraft, environmental and industrial applications. Fundamental research is conducted to gain knowledge and understanding on multi-input-multi-output systems, distributed parameter systems and nonlinear plants with uncertainty, and to develop new methodologies to design quantitative robust controllers to improve the efficiency and reliability of such systems.

The CESC’s expertise has been applied to real-world problems with industrial partners and space agencies in the following main areas:

- Multi-Megawatt Onshore and Offshore Wind Turbines
- Airborne Wind Energy Systems
- Renewable Energy Plants, Advanced Energy Systems
- Power System Dynamics and Control, Grid Integration, Energy Storage
- Large Radio Telescope Control, Optical Telescope Control
- Formation Flying Spacecraft, Satellites with Flexible Appendages
- Wastewater Treatment Plants, Desalination Systems
- Heating Systems, Fluid Dynamics
- Robotics, Parallel Kinematics

The CESC’s capabilities and equipment include:

- Fully instrumented wind tunnel to test prototypes at wind speeds up to 20 m/s
- Lab-scale wind turbine blade manufacturing units
- State-of-the-art computer programs for commercial wind turbine design
- Aerodynamics, Solid modeling and Electrical design CAD/CAE software
- Advanced software to design robust QFT control systems
- Software for analysis and simulation of dynamic systems
- Multiple laboratory scale wind turbines with a variety of collinear and orthogonal rotors, electrical generators, gearboxes, sensors, actuators and hierarchical real-time torque/pitch/yaw control systems
- Lab-scale wind farms with flexible configurations
- Fully-controlled 6-DOF Stewart platform for lab-scale Floating Wind Turbine experimentation
- Laboratory helicopter to test advanced control systems

Electronics Design Center (EDC)

112 Bingham (7200)
Phone: 216.368.2935 Fax: 216.368.8738
Chung-Chiu Liu, Director
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The Electronics Design Center (EDC) is a multi-disciplinary educational and research center focusing on the applications of microfabrication processing to the advancement of chemical and biological micro-systems specializing in application-oriented electrochemical based biosensors. The center has complete thick film and thin film processing facilities, including screen printing, ink jet printing and sputtering equipment. Other facilities supporting the microfabrication processing are also readily available. The EDC is a resource for industrial and academic researchers, offering access to equipment, laboratories and trained staff.

Great Lakes Energy Institute (GLEI)

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Phone: 216.368.0748
Alexis Abramson, Director
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The Great Lakes Energy Institute empowers faculty, students and partners to catalyze breakthroughs in energy sustainability that address the most pressing problems facing our world. Since 2008, GLEI has helped catalyze a five-fold increase in energy research, won awards from NSF, DOE, (ARPA-E, EERE, OE), Ohio Third Frontier and other organizations, attracted over $80 million in awards, worked with over 100 different industry partners, and encouraged multidisciplinary proposals throughout the university. At the heart of these efforts are over 90 engaged faculty, hailing from engineering, arts & sciences, management, and law. And while GLEI’s work supports all types of energy, the focus lies in five priority areas:

Future Power - CWRU’s energy program is underpinned by research in power systems. Strengths in controls, sensors, and electronics provide a core foundation for smart grid connectivity of energy and storage.
Energy Storage - Storage research builds on historical strengths in electrochemistry, materials and lifetime and degradation science. Recent research awards include ARPA-E and DOE.

Solar - Research in next generation photovoltaics (PV) focuses on organics and lifetime and degradation science, stemming from a strong reputation in materials, research, and development.

Wind Energy - Wind energy emphasizes offshore deployment and is founded on wind and ice measurement, controls, power management, and grid interface expertise. Much of this work is supported by DOE awards and the State of Ohio.

Oil and Gas - Research focuses on technologies that enhance safe extraction, transport and processing of shale gas and oil in Ohio. Strengths are present in macromolecules, sensors, corrosion-resistant casings, cementitious materials, and modeling and simulation of hydro-fracking process.

The role of CWRU in energy also touches economic development and education. Through research and investment, university spin-outs are poised to contribute to a new energy economy while working toward a clean and sustainable future. Students undertake key roles in the research and commercialization of the energy technologies contributing to worldwide impact.

Materials for Opto/Electronics Research and Education Center (MORE)

616 White Building (7204)
Phone: 216.368.4007
Ina Martin, Director
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The Materials for Opto/Electronics Research and Education (MORE) Center advances science and innovation with facilities and expertise enabling the fabrication and characterization of materials and devices for emerging electronic and optoelectronic technologies, including solar cells and lighting. Located in the Charles M. White Metallurgy Building, the MORE Center is a hub for undergraduate and graduate research, education, and collaboration. The center has 30 tools available for both direct use and service work; in addition to a suite of thin film deposition options, the MORE Center has large-area profilometry, ellipsometry, mechanical testing, and microscopy characterization tools, a cleanroom facility, electron and photolithography capabilities, and inert gloveboxes for work with air-sensitive materials.

Established in 2011, the MORE Center has amassed over 300 users from 30 research groups across the College of Arts and Sciences, the Case School of Engineering, and the CWRU School of Medicine. The MORE Center is open to internal and external academic and industrial users.

Microfabrication Laboratory (MFL)

342 Bingham Building (7200)
Phone: 216.368.6117 Fax: 216.368.6888
Christian Zorman, Director
christian.zorman@case.edu

MFL houses a state-of-the-art facility that provides the latest in microfabrication and micromachining processes. The laboratory focuses on the applications of microfabrication and micromachining technology to a wide range of sensors, actuators and other microelectromechanical (MEMS) systems. In addition to silicon based technology, the laboratory has a unique strength in silicon carbide micromachining that is particularly valuable for applications in harsh environments. To support the development of flexible microsystems, polymer micromachining is also available. Undergraduate students, graduate students, and post-doctoral assistants use the laboratory’s facilities to carry out their research or special projects.

Researchers not affiliated with CWRU can also use the laboratory through a facilities use agreement.

National Center for Space Exploration Research (NCSER)

21000 Brookpark Rd., MS 110-3
Phone: 216.433.5031
Mohammad Kassemi, Director
mohammad.kassemi@case.edu

The National Center for Space Exploration Research (NCSER) is a collaborative effort between the Universities Space Research Association (USRA), Case Western Reserve University (CWRU), and NASA Glenn Research Center (GRC) that under the NASA Advanced Research and Technology Service (ARTS) contract provides GRC with specialized research and technology development capabilities essential to sustaining its leadership role in NASA missions. Expertise resident at NCSER includes reduced gravity fluid mechanics, reduced gravity combustion processes; heat transfer, two-phase flow, micro-fluidics, and phase change processes; computational multiphase fluid dynamics, heat and mass transfer, computational simulation of physico-chemical fluid processes and human physiological systems. This expertise has been applied to:

- Cryogenic fluid management
- On orbit repair of electronics
- Spacecraft fire safety
- Exploration life support
- Energy storage
- Dust management
- Thermal management and control
- Environmental monitoring/control
- ISS experiment development Integrated system health monitoring
- Astronaut health
- Planetary Surface Mobility
- In situ resource utilization
- Materials synthesis
- Bio-fluid mechanics
- Biosystems modeling
- Fluid-Structural-Interaction and tissue mechanics in physiological systems.

Neural Engineering Center (NEC)

112 Wickenden (7207)
Phone: 216.368.3974 Fax: 216.368.4872
Dominique Durand, Director
dominique.durand@case.edu

The research mission of the center is to bring to bear combined tools in physics, mathematics, chemistry, engineering and neuroscience to analyze the mechanisms underlying neuronal function and to solve the clinical problems associated with neuronal dysfunction. Research
areas include: Neuromodulation, Neuroprostheses, Quantitative Neurophysiology, Neural Dynamics, Neuro-Mechanical Systems, Neural Regeneration, Neural Interfacing, Neural Imaging and Molecular Sensing, Neuro-Magnetism, and Systems Neuroscience. The education mission of the center is to provide engineers and scientists with an integrated knowledge of engineering and neuroscience capable of solving problems in neuroscience ranging from the molecules to the clinic. The center is also an outlet for technology transfer of new ideas to be commercialized by industrial partners. The center’s goals are accomplished by fostering interdisciplinary research between clinicians, scientists, students and local industry, educational experiences including didactic material, laboratory experience and clinical exposure, and close ties to industrial partners.

**Nitinol Commercialization Accelerator (NCA)**

White Building (7205)  
Phone: 216.368.4234  
John J. Lewandowski, Director  
john.lewandowski@case.edu  
James D. McGuffin-Cawley, Co-Director  
David Schwam, Co-Director

The Ohio Third Frontier Wright Projects Program has funded the Nitinol Commercialization Accelerator (NCA), a collaborative effort between the Cleveland Clinic, CWRU, University of Toledo, NASA Glenn Research Center, and Norman Noble, Inc. in order to develop a better understanding of the metallurgical processing and mechanical characterization of nitinol for use in biomedical and aerospace applications. Biomedical applications range from orthodontia to implantable devices while higher temperature shape memory alloys are of interest for aerospace. The collaboration is designed to create synergy amongst collaborators in the research and development of nitinol products.

The laboratory housed at CWRU’s Material Science and Engineering Department contains processing and characterization (thermal and mechanical) equipment that allows for the manufacture and analysis of nitinol products. Processing equipment includes a vacuum arc casting unit, vacuum heat treatment system, and hot extrusion capabilities. Thermal characterization equipment includes a high temperature Differential Scanning Calorimeter (DSC) while mechanical characterization equipment for testing wire/foil includes a number of flex bending fatigue machines, rotary bending fatigue machines, and tabletop tension testing machines.

The Cleveland Clinic and NASA Glenn Research Center also house equipment associated with the NCA program including: Raydiance-Rofin Femtosecond Laser, Techne FB-08 Precision Calibration Bath, MTS Cryochamber and Grips, and an Aramis/Optotrac Certus 3D Strain Mapping system.

**SDLE Research Center**

Labs: White Building, 5th Floor / Sun Farm: CWRU West Campus  
Phone: 216.368.3655/216.368.0374  
Roger H. French, Director  
roger.french@case.edu

Christopher Littman, Business Development Director & Operations Manager  
christopher.littman@case.edu

The SDLE Research Center was established in 2011 with funding from Ohio Third Frontier, and is dedicated to advancing the field of lifetime and degradation science. The research center activities focus on durability and degradation of environmentally exposed, long lived materials and technologies such as photovoltaics (PV), energy efficient lighting, and building envelope applications. The Center develops real-time and accelerated protocols for exposure to solar radiation and related environmental stressors to enable the evaluation of the environmental durability and lifetime of materials, components, and products. Data scientists identify statistically significant relationships using a data analytics platform (Energy-CRADLE) developed in the center. Researchers perform post-exposure optical and thermo-mechanical measurements to develop quantitative mechanistic models of degradation processes. The SDLE Research Center’s capabilities and equipment include:

- Outdoor solar exposures: SunFarm with 14 dual-axis solar trackers with multi-sun concentrators, and power degradation monitoring  
- Solar simulators for 1-1000X solar exposures  
- Multi-factor environmental test chambers with temperature, humidity, freeze/thaw, and cycling  
- A full suite of optical, interfacial, thermo-mechanical and electrical evaluation tools for materials, components and systems

**Swagelok Center for Surface Analysis of Materials (SCSAM)**

110 Glennan Building  
Phone: 216.368.3868  
Frank Ernst, Faculty Director  
frank.ernst@case.edu

Amir Avishai, Director  
amir.avishai@case.edu

The Swagelok Center for Surface Analysis of Materials is one of Case Western Reserve University’s largest core facilities, providing a variety of instrumentation for microstructural and compositional characterization of materials as well as surface and near-surface chemical analysis. A staff of professionals are available to assist and train academic researchers and commercial users of the Center’s equipment. Fully trained users are permitted independent access to the instruments, while users with particularly difficult samples or those who are unsure how to obtain the best possible data can utilize the services of staff experts. Some of the routine services offered include guidance with sample preparation, technical assistance to obtain data, and data analysis. Additionally, the expert staff are available to meet with research groups to assist with acquiring data needed for proposal submission as well as consulting and developing methods tailored to fit specific research needs.

The Center is administered by the Case School of Engineering and used by undergraduate students, graduate students, post-doctoral researchers. SCSAM instruments are utilized by more than 40% of the Engineering School’s faculty as well as researchers from the College of Arts and Sciences, the School of Medicine and the Dental School. Further, the Center serves as a micro-characterization hub for over 100 external commercial and non-profit entities, including the NASA Glenn Research Center, the Cleveland Clinic, numerous Ohio universities, and over 70 industrial R&D laboratories. Combined internal and external usage of the Center exceeds 250 users each year. Instruments are housed in a
centralized area, allowing convenient access to the equipment and expert knowledge to provide state-of-the-art solutions.

**ANALYTICAL SERVICES**

**Electron Microscopy**
- FIB-SEM (Focused ion beam / scanning electron beam microscopy), including XEDS (X-ray energy-dispersive spectroscopy), EBSD (electron backscatter diffraction), TKD mapping (transmission Kikuchi diffraction), 3D imaging and reconstruction.
- TEM (transmission electron microscopy), including scanning TEM, XEDS, EELS (electron energy-loss spectrometry), and high-resolution grain orientation mapping using a TopSpin system.

**Surface Analysis Scanning**
- Scanning Auger microprobe.
- XPS/ESCA (X-Ray photoelectron spectrometry).
- ToF-SIMS (Time-of-flight secondary ion-mass spectrometry).

**Other Methods**
- Scanning probe microscopy, including AFM (atomic force microscopy) and MFM (magnetic force microscopy).
- Light-optical microscopy.
- XRD (X-Ray diffractometry).
- Nanomechanical testing, including nanohardness, nanoscratching, and nanowear testing.
- Ion polishing.
- Nanomill post-preparation of TEM specimens.
- Semi-automated metallographic specimen preparation.

A detailed equipment list and description are available at http://engineering.case.edu/centers/scsam/.

**Wind Energy Research and Commercialization (WERC) Center**

307 Olin Building
Great Lakes Energy Institute
Phone: 216.368.1366, Fax: 216.368.3209
David H. Matthiesen, Director
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The WERC Center is a multidisciplinary center for use by students, faculty, and industry providing instrumentation for wind resource characterization and research platforms in operating wind turbines. The WERC Center was established in 2010 with funding from the Ohio Department of Development Third Frontier Wright Project and the Department of Energy. Additional support was provided by the following inaugural industrial partners: Cleveland Electric Laboratories, The Lubrizol Corporation, Parker Hannifin Corporation, Azure Energy LLC., Rockwell Automation, Inc., Swiger Coil Systems LLC, and Wm. Sopko & Sons Co.

The instruments in the WERC Center include:

- A continuous scan ZephIR LiDAR, manufactured by Natural Power. This instrument measures horizontal and vertical wind velocity along with wind direction at 15 second intervals at five user set heights up to 200 m.

- Five meteorological measurement systems: 3 on campus; 1 with the off-campus wind turbines; and one at the City of Cleveland’s water intake crib located 3.5 miles offshore in Lake Erie.
- An ice thickness sensor that is deployed at the bottom of Lake Erie each fall and retrieved in the spring.
- A NorthWind 100 wind turbine manufactured by Northern Power Systems in Barre, Vermont, USA. This 100kW community scale wind turbine has a direct drive generator with full power inverters, stall control blades with a 21 m rotor diameter, and a 37 m hub height. This wind turbine is located on campus just east of Van Horn field and began operation in November, 2010.
- A Vestas V-27 wind turbine originally manufactured by Vestas in Denmark. This 225kW medium scale wind turbine has a gearbox drive generator, pitch controlled blades with a 27 m rotor diameter, and a 30 m hub height. In addition it has a 50kW generator for low wind generation. This wind turbine is located at an industrial site in Euclid, OH about 15 minutes from campus and began operation in March, 2012.
- A Nordex N-54 wind turbine originally manufactured by Nordex in Germany. This 1.0MW utility scale wind turbine has a gearbox drive generator, stall control blades with a 54 m rotor diameter, and a 70 m hub height. In addition it has a 200kW generator for low wind generation. This wind turbine is located at an industrial site in Euclid, OH about 15 minutes from campus and began operation in October, 2012.

**Educational Facilities**

**CSE Portal** (https://cseportal.cwru.edu)
The CSE Portal is a virtual computer lab available to students, faculty, and staff in the Case School of Engineering. The virtual lab utilizes Citrix technology to deliver Windows desktops and software applications to users at any time, in any location, and on any device. Users can run available applications, such as SolidWorks or Matlab, on Windows and Mac computers, as well as Android, iOS, and Windows tablets and smartphones. All application processing takes place on the secure CSE server infrastructure, so users experience consistent performance regardless of the device being used.

To use the CSE Portal from a desktop or laptop, simply go to the following website from your browser: https://cseportal.cwru.edu

For instructions on how to setup your tablet or smartphone to access the CSE portal, please visit: http://engineering.case.edu/it/citrix

For a complete list of applications currently available on the CSE Portal, please visit: http://engineering.case.edu/it/available-applications-through-citrix-xenapp

**Nord Computer Laboratory** (http://engineering.case.edu/about/facilities/nord-computer-lab)
The Nord Computer Laboratory is a general purpose computer facility, provided by the Case School of Engineering, open 24 hours a day, available to all CWRU students. The lab contains 56 Thin Clients running Windows 7 Enterprise. Software includes MS Office, MATLAB, SolidWorks, Aspen, MultiPhysics, ChemBioDraw, CES EduPack, and many others. Facilities for color printing, faxing, copying and scanning are provided.
Larry Sears and Sally Zlotnick Sears think[box] (http://thinkbox.case.edu)

Housed in the newly opened, newly renovated Richey Mixon Building, the Larry Sears and Sally Zlotnick Sears think[box] houses all the resources budding innovators need to bring their ideas to life. At 50,000 square feet, it is one of the world’s largest campus-based innovation centers. The first four floors are now open to the public, each dedicated to a specific stage of the innovation process, including open areas and meeting spaces for interaction, prototyping tools and equipment, a fabrication machine shop and project space.

Three additional floors are planned for subsequent phases of construction, dedicated to project building, entrepreneurship resources, incubator space and community programming.

Vision
The vision of think[box] is to change the economic and social culture of the university and region by emphasizing cross-discipline and cross-institution collaborative endeavors that push creativity and innovation to their limits. Think[box] will provide a project-based learning environment where students from all courses of study have an opportunity to understand how innovation and creativity can lead to economic and social advancement. This exposure will encourage entrepreneurial thinking among our students, who will then be poised to become the leaders and innovators of the future. Simultaneously, think[box] will create an entrepreneurial environment where these ideas can be nurtured, developed, funded, and commercialized.

Mission
The mission of think[box] is to establish, on campus, a physical and cultural focal point that will:

- Provide an educational environment that fosters collaboration, creativity, and invention.
- Provide comprehensive resources for innovation and value creation.
- Create an engine for entrepreneurial growth within our community by identifying and nurturing the talents and expertise of CWRU students, faculty, and staff, as well as those of the surrounding community.

Administration
James McGuffin-Cawley, PhD
(Case Western Reserve University)
Interim Dean of the Case School of Engineering and Arthur S. Holden Professor of Engineering

Marc Buchner, PhD
(Michigan State University)
Associate Dean of Academics

Lisa Camp, MS
(Case Western Reserve University)
Associate Dean of Strategic Initiatives

Daniel Ducoff, MS
(University of California, Berkeley)
Vice Dean for External Relations of the Case School of Engineering

Cena Hilliard, MS
(University of Wisconsin-Madison)
Associate Dean of Finance, Administration, and Business Operations

Deborah J. Fatica, MA
(Bowling Green State University)
Assistant Dean of the Division of Engineering Leadership and Professional Practice

K. Peter D. Lagerlof, PhD
(Case Western Reserve University)
Faculty Director of Program Evaluation and Assessment

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The Department of Biomedical Engineering was established in 1968 at Case Western Reserve University, founded on the premise that engineering principles provide an important basis for innovative and unique solutions to a wide range of biomedical and clinical challenges. As one of the pioneering programs in the world, the department has established rigorous yet flexible educational programs that are emulated by many other institutions, and is a national leader in cutting edge research in several important areas. The cornerstone of the program is quantitative engineering and analytic methods for biomedical applications, a feature that distinguishes Biomedical Engineering from other biomedical science programs. The department’s educational programs provide training in cellular and subcellular mechanisms for understanding fundamental physiological processes, in dealing with biomedical problems at the tissue and organ system level, and in integrating this knowledge in systems approaches to solving clinical problems.

Current degree programs include the BS, MS, ME, combined BS/MS, PhD, MD/MS, and MD/PhD in Biomedical Engineering. In all of the BME programs at Case, the goal is to educate engineers who can apply engineering methods to problems involving living systems. The Case School of Engineering and the School of Medicine are in close proximity on the same campus, and Biomedical Engineering faculty members carry joint appointments in both of these two schools, participating in the teaching, research, and decision-making committees of both.

The department is also tightly linked with several major medical centers (University Hospitals, Cleveland Clinic, VA Medical Center, and MetroHealth Medical Center) that are nearby. As a result, there is an unusually free flow of academic exchange and collaboration in research and education among the two schools and the four medical institutions. All of Case Western Reserve’s BME programs take full advantage of these close relationships, which adds significant strength to the programs.

Mission
To educate leaders who will integrate principles of both engineering and medicine to create knowledge and discoveries that advance human health and well-being. Our faculty and students play leading roles ranging from basic science discovery to the creation, clinical evolution, and commercialization of new technologies, devices, and therapies. In short, we are “Engineering Better Health.”
Background
Graduates in biomedical engineering are employed in industry, hospitals, research centers, government, and universities. Biomedical engineers also use their undergraduate training as a basis for careers in business, medicine, law, consulting, and other professions.

Research
Several research thrusts are available to accommodate various student backgrounds and interests. Strong research collaborations with clinical and basic science departments of the university and collaborating medical centers bring a broad range of opportunities, expertise, and perspective to student research projects.

Biomaterials/Tissue Engineering/Drug and Gene Delivery
Fabrication and analysis of materials for implantation, including neural, orthopaedic, and cardiovascular tissue engineering, biomimetic materials, liposomal and other structures for controlled, targeted drug delivery, and biocompatible polymer surface modifications. Analysis of synthetic and biologic polymers by AFM, nanoscale structure-function relationships of biomaterials. Applications in the nervous system, the cardiovascular system, the musculoskeletal system, and cancer.

Biomedical Imaging
MRI, PET, SPECT, CT, ultrasound, acoustic elastography, optical coherence tomography, cardiac electrical potential mapping, human visual perception, image-guided intervention, contrast agents. In vivo microscopic and molecular imaging, and small animal imaging.

Biomedical Sensing
Optical sensing, electrochemical and chemical fiber-optic sensors, chemical measurements in cells and tissues, endoscopy.

Big Data Analytics and Health Informatics
Radiomics, Radiogenomics, computer assisted diagnosis, digital pathology, co-registration, cancer detection, decision making, precision medicine, bioinformatics, image informatics, machine learning, pattern recognition, artificial intelligence, deep learning.

Neural Engineering and Neural Prostheses
Neuronal mechanisms; neural interfacing for electric and magnetic stimulation and recording; neural dynamics, ion channels, second messengers; neural prostheses for control of limb movement, bladder, bowel, and respiratory function; neuromodulation systems for movement disorders, epilepsy, pain mitigation, visceral functions; computational modeling and simulation of neural structures.

Transport and Metabolic Systems Engineering
Modeling and analysis of tissue responses to heating (e.g., tumor ablation) and of cellular metabolism related to organ and whole-body function in health (exercise) and disease (cardiac).

Biomechanical Systems
Computational musculoskeletal modeling, bone biomechanics, soft tissue mechanics, control of neuromechanics for motor function, neuromuscular control systems, human locomotion, cardiac mechanics.

Cardiovascular Systems
Normal cardiac physiology, pathogenesis of cardiac diseases, cardiac development, therapeutic technologies, including cardiac regeneration; electrophysiological techniques, imaging technologies, mathematical modeling, gene regulation, molecular biology techniques; cardiac bioelectricity and cardiac biomechanics.

Undergraduate Programs
The Case Western Reserve undergraduate program leading to the Bachelor of Science degree with a major in biomedical engineering was established in 1972. The B.S. degree program in BME is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

Some BS graduates are employed in industry and medical centers. Others continue graduate or professional studies in biomedical engineering and other fields. Students with engineering ability and an interest in medicine may consider the undergraduate biomedical engineering program as an exciting alternative to conventional premedical programs. In addition to the University general education requirements the undergraduate program has three major components: (1) Engineering Core, (2) BME Core, and (3) BME speciality tracks. The Engineering Core provides a fundamental background in mathematics, sciences, and engineering. The BME Core integrates engineering with biomedical science to solve biomedical problems. Hands-on experience in BME is developed through undergraduate laboratory and project courses. In addition, by choosing BME Track Courses, the student can study a specific area in depth. This integrated program is designed to ensure that BME graduates are competent engineers. Students may select open electives for educational breadth or depth or to meet entrance requirements of medical school or other professional career choices. BME faculty serve as student advisors to guide students in choosing the program of study most appropriate for individual needs and interests.

Program Educational Objectives
At the undergraduate level, we direct our efforts toward two educational objectives that describe the performance of alumni 3-6 years after graduation.

1. Our graduates will successfully enter and complete post-baccalaureate advanced degree programs, including those in biomedical engineering.
2. Our graduates will obtain jobs in the biomedical arena and advance to positions of greater responsibility.

Student Outcomes
As preparation for achieving the above educational objectives, the BS degree program in Biomedical Engineering is designed so that students can:

Student Outcomes
As preparation for achieving the above educational objectives, the BS degree program in Biomedical Engineering is designed so that students attain:

• An ability to apply knowledge of mathematics, science, and engineering appropriate to the biomedical engineering
• An ability to design and conduct experiments, as well as to analyze and interpret data
• An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
• An ability to function on multi-disciplinary teams
• An ability to identify, formulate, and solve engineering problems
• An understanding of professional and ethical responsibility
• An ability to communicate effectively
• The ability to communicate the impact of engineering solutions in a global, economic, environmental, and societal context
• A recognition of the need for, and an ability to engage in life-long learning
• A knowledge of contemporary issues
• An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Bachelor of Science in Engineering
Major in Biomedical Engineering
In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

Required Courses

<table>
<thead>
<tr>
<th>Major Courses</th>
<th>Major Courses</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBME 201</td>
<td>Physiology-Biophysics I</td>
<td>3</td>
</tr>
<tr>
<td>EBME 202</td>
<td>Physiology-Biophysics II</td>
<td>3</td>
</tr>
<tr>
<td>EBME 306 &amp; EBME 356</td>
<td>Introduction to Biomedical Materials and Introduction to Biomaterials Engineering - Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>EBME 308 &amp; EBME 358</td>
<td>Biomedical Signals and Systems and Biomedical Signals and Systems Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>EBME 309 &amp; EBME 359</td>
<td>Modeling of Biomedical Systems and Biomedical Computer Simulation Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>EBME 310 &amp; EBME 360</td>
<td>Principles of Biomedical Instrumentation and Biomedical Instrumentation Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>EBME 370</td>
<td>Principles of Biomedical Engineering Design</td>
<td>2</td>
</tr>
<tr>
<td>EBME 380</td>
<td>Biomedical Engineering Design Experience</td>
<td>3</td>
</tr>
<tr>
<td>Plus one engineering, Mathematics or Natural Science Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Plus 8 Specialty Track Specialization Courses (see below)</td>
<td>24-26</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
<td>54-56</td>
<td></td>
</tr>
</tbody>
</table>

Natural Sciences, Mathematics or Statistics Elective
Candidates for the Bachelor of Science in Engineering (BSE) degree must fulfill a Natural Sciences, Mathematics or Statistic requirement, which is designated by the major department. Biomedical Engineering majors may meet this requirement by taking one of the following statistics courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
<td>3</td>
</tr>
<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
<td>3</td>
</tr>
<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>STAT 333</td>
<td>Uncertainty in Engineering and Science</td>
<td>3</td>
</tr>
</tbody>
</table>

Biomedical Engineering Specialty Tracks
Majors in Biomedical Engineering choose a specialization track, with track specific courses.

Required courses for these tracks are presented in the tables below. These tracks provide the student with a solid background in a well-defined area of biomedical engineering. To meet specific educational needs, students may choose alternatives from among the suggested electives or design unique specialities. These options for flexibility subject to departmental guidelines and faculty approval.

Biomedical Devices and Instrumentation Track

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 245</td>
<td>Electronic Circuits</td>
<td></td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td></td>
</tr>
<tr>
<td>EECS 309</td>
<td>Electromagnetic Fields I</td>
<td></td>
</tr>
<tr>
<td>EECS 344</td>
<td>Electronic Analysis and Design</td>
<td></td>
</tr>
<tr>
<td>Approved Tech Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Approved Tech Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Approved Tech Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Con-joiner course: choose one of the following courses:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>EBME 320</td>
<td>Medical Imaging Fundamentals</td>
<td></td>
</tr>
<tr>
<td>EBME 327</td>
<td>Bioelectric Engineering</td>
<td></td>
</tr>
</tbody>
</table>

The following courses are pre-approved, technical electives for the Biomedical Devices and Instrumentation track. Other technical courses can be approved by the track leader and the student’s advisor, that are consistent with the track and are consistent with student’s career plans. Students are encouraged to choose electives that form a thematic depth.

Electronics:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 321</td>
<td>Semiconductor Electronic Devices</td>
<td></td>
</tr>
<tr>
<td>EECS 322</td>
<td>Integrated Circuits and Electronic Devices</td>
<td></td>
</tr>
<tr>
<td>EECS 371</td>
<td>Applied Circuit Design</td>
<td></td>
</tr>
<tr>
<td>EECS 312 instead of ENGR 131</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td></td>
</tr>
<tr>
<td>EECS 313</td>
<td>Signal Processing</td>
<td></td>
</tr>
<tr>
<td>EECS 337</td>
<td>Compiler Design</td>
<td></td>
</tr>
<tr>
<td>EECS 338</td>
<td>Intro to Operating Systems and Concurrent Programming</td>
<td></td>
</tr>
<tr>
<td>EECS 340</td>
<td>Algorithms</td>
<td></td>
</tr>
<tr>
<td>EECS 351</td>
<td>Communications and Signal Analysis</td>
<td></td>
</tr>
<tr>
<td>EECS 354</td>
<td>Digital Communications</td>
<td></td>
</tr>
<tr>
<td>EECS 324</td>
<td>Modeling and Simulation of Continuous Dynamical Systems</td>
<td></td>
</tr>
<tr>
<td>EECS 346</td>
<td>Engineering Optimization</td>
<td></td>
</tr>
<tr>
<td>EBME 478</td>
<td>Computational Neuroscience</td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EBME 401D</td>
<td>Biomedical Instrumentation and Signal Processing</td>
<td></td>
</tr>
<tr>
<td>EBME 407</td>
<td>Neural Interfacing</td>
<td></td>
</tr>
<tr>
<td>EBME 421</td>
<td>Bioelectric Phenomena</td>
<td></td>
</tr>
</tbody>
</table>
### Biomaterials Track

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
</tr>
<tr>
<td>EMAC 270</td>
<td>Introduction to Polymer Science and Engineering</td>
</tr>
<tr>
<td>EMAC 351</td>
<td>Physical Chemistry for Engineering</td>
</tr>
<tr>
<td>EMAC 352</td>
<td>Polymer Physics and Engineering</td>
</tr>
</tbody>
</table>

Approved Tech. Elective 3

Approved Tech. Elective 3

Approved Tech. Elective 3

Con-joiner course: choose one of the following courses: 3

- EBME 316 Biomaterials for Drug Delivery
- EBME 325 Introduction to Tissue Engineering
- EBME 305 Materials for Prosthetics and Orthotics

The following courses are pre-approved, technical electives for the Biomaterials track. Other technical courses can be approved by the track leader and the student’s advisor that are consistent with the track and are consistent with student’s career plans. Students are encouraged to choose electives that form a thematic depth.

**Polymeric Biomaterials**

- EMAC 276 Polymer Properties and Design
- EMAC 355 Polymer Analysis Laboratory
- EMAC 370 Polymer Chemistry
- EMAC 376 Polymer Engineering
- EMAC 377 Polymer Processing
- EBME/EMAC 303 Structure of Biological Materials
- EBME 305 Materials for Prosthetics and Orthotics
- EBME 350 Quantitative Molecular, Cellular and Tissue Bioengineering
- EBME 406/EMAC 471 Polymers in Medicine
- EBME 325 Introduction to Tissue Engineering

### Biomechanics Track

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAE 160</td>
<td>Mechanical Manufacturing</td>
</tr>
<tr>
<td>EMAE 181</td>
<td>Dynamics</td>
</tr>
<tr>
<td>ECIV 310</td>
<td>Strength of Materials</td>
</tr>
<tr>
<td>EMAE 260</td>
<td>Design and Manufacturing I</td>
</tr>
</tbody>
</table>

Approved Tech Elective 3

Approved Tech Elective 3

Approved Tech Elective 3

Co-joiner course: 3

- EBME 307 Biomechanical Prosthetic Systems

The following courses are pre-approved, technical electives for the Biomechanics track. Other technical courses can be approved by the track leader and the student’s advisor that are consistent with the track and are consistent with student’s career plans. Students are encouraged to choose electives that form a thematic depth.

- EMAE 250 Computers in Mechanical Engineering
- EMAE 290 Computer-Aided Manufacturing
- EMAE 363 Mechanical Engineering Modern Analysis Methods
### Biomedical Engineering

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAE 390</td>
<td>Advanced Manufacturing Technology</td>
</tr>
<tr>
<td>EMAE 370</td>
<td>Design of Mechanical Elements</td>
</tr>
<tr>
<td>EMAE 372</td>
<td>Structural Materials by Design</td>
</tr>
<tr>
<td>EMAE 350</td>
<td>Mechanical Engineering Analysis</td>
</tr>
<tr>
<td>EMAE 415</td>
<td>Introduction to Musculo-skeletal Biomechanics</td>
</tr>
<tr>
<td>EBME 305</td>
<td>Materials for Prosthetics and Orthotics</td>
</tr>
<tr>
<td>EBME 402</td>
<td>Organ/Tissue Physiology and Systems Modeling</td>
</tr>
<tr>
<td>ECIV 420</td>
<td>Finite Element Analysis</td>
</tr>
<tr>
<td>EBME 398</td>
<td>Biomedical Engineering Research Experience I</td>
</tr>
<tr>
<td>EMSE 372</td>
<td>Structural Materials by Design</td>
</tr>
</tbody>
</table>

*Please click here to download the Biomechanics Track example program of study (http://bulletin.case.edu/schoolofengineering/biomedicalengineering/X20170302a_BioMechanicsTrack_Generic.xls)*

*Requirements for a minor in Mechanical Design and Manufacturing Engineering can be found here (p. 113). These can usually be satisfied by judiciously selecting technical electives. Consult your adviser.

### Biomedical Computing and Analysis Track

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 302</td>
<td>Discrete Mathematics</td>
</tr>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
</tr>
<tr>
<td>MATH 201</td>
<td>Introduction to Linear Algebra for Applications</td>
</tr>
<tr>
<td>EECS 324</td>
<td>Modeling and Simulation of Continuous Dynamical Systems</td>
</tr>
<tr>
<td>Approved Tech. Elective</td>
<td>3</td>
</tr>
<tr>
<td>Approved Tech. Elective</td>
<td>3</td>
</tr>
<tr>
<td>Approved Tech. Elective</td>
<td>3</td>
</tr>
<tr>
<td>Co-joiner course: choose one of the following courses:</td>
<td>3</td>
</tr>
<tr>
<td>EBME 307</td>
<td>Biomechanical Prosthetic Systems</td>
</tr>
<tr>
<td>EBME 327</td>
<td>Bioelectric Engineering</td>
</tr>
<tr>
<td>EBME 350</td>
<td>Quantitative Molecular, Cellular and Tissue Bioengineering</td>
</tr>
<tr>
<td>EBME 361</td>
<td>Biomedical Image Processing and Analysis</td>
</tr>
</tbody>
</table>

*Requirements for a minor in Systems and Control Engineering can be found here (p. 63). These can usually be satisfied by judiciously selecting technical electives. Consult your adviser.

### Bachelor of Science in Engineering

#### Suggested Program of Study: Major in Biomedical Engineering

The following is an example program of study. Variations depend on advance placements. Students should work with their advisors to map out an individual plan of study.

**First Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Biomedical Engineering (EBME 105)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary Computer Programming (ENGR 131/EECS 132)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAGES First Seminar (FSxx)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHED (2 half semester courses)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry of Materials (ENGR 145)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiology-Biophysics I (EBME 201)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)**</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar (USxx)*</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physiology-Biophysics II (EBME 202)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224)**</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)**</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>One of the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BME Track Course b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science elective e</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humanities or Social Science Course **</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Year Total:</strong></td>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

### Third Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Biomedical Materials (EBME 306) &amp; Introduction to Biomaterials Engineering - Laboratory (EBME 356)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>BME Track Course b</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGR 398)**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGL 398)**</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Biomedical Signals and Systems (EBME 308) &amp; Biomedical Signals and Systems Laboratory (EBME 358)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Humanities or Social Science Course **</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Principles of Biomedical Instrumentation (EBME 310) &amp; Biomedical Instrumentation Laboratory (EBME 360)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Statics and Strength of Materials (ENGR 200)**</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Modeling of Biomedical Systems (EBME 309) &amp; Biomedical Computer Simulation Laboratory (EBME 359)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>BME Track Course d</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Humanities or Social Science Course **</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total Year Total:</strong></td>
<td>17</td>
<td>16</td>
</tr>
</tbody>
</table>

### Fourth Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities or Social Science Course **</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Principles of Biomedical Engineering Design (EBME 370)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BME Track Course b</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### Total Units in Sequence:

- University general education requirement
- Engineering general education requirement
- This optional course is limited to first-year students and is not required.
- Courses chosen depending on the BME specialty track as listed above
- At least one engineering, math, or natural science elective
- SAGES BME Department Seminar, ENGL 398 Professional Communication for Engineers and ENGR 398 Professional Communication for Engineers must be taken together
- STAT 312, 313, 332, 333 fulfill the statistics requirement. Consult your advisor to determine the most appropriate class
- Biomedical Computing and Analysis track requires EECS 132

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**Co-op and Internship Programs**

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop.

Alternatively or additionally, students may obtain employment as summer interns.

**BS/MS Program**

The BS/MS program is designed to allow highly qualified undergraduate students from the Case BME program to integrate B.S. courses and project work with M.S. courses and research. Nominally, the combined program can be completed in 5 years that includes 3 summers starting after the junior year. The BS/MS program can reduce the time required to receive an MS degree because up to three courses taken during the undergraduate program at Case can be "double counted" towards M.S. requirements and because a research project can begin before the completion of the B.S. degree. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).
Applications to the BS/MS program should be submitted before the end of Spring semester in the junior year. The final deadline for BS/MS admissions is August 1 before the senior year. This will enable the GEC sufficient time to review the application and allow students to make any required changes to their POS for fall semester.

In general the following steps should be taken to apply to the BS/MS program:

1. See Advisor to discuss interests (typically in junior year or earlier).
2. See Dean Anderson the Undergraduate office to discuss intentions.
3. Complete a School of Graduate Studies application and submit to the Graduate Studies office for the program of interest (BME).
4. Complete a planned Program of Study form (must be signed by student, Faculty Advisor, Department Chair, and Dean of Undergraduate Studies). (see Appendix for BS/MS PPOS form).

Additional information for BME students:

1. An eligible BME faculty member (primary or secondary) must agree to serve as the M.S. research advisor and a primary BME faculty member (who might be the same person as the research advisor) must agree to be the academic advisor. Obtaining this agreement is the responsibility of the applying student. The BS/MS application must include letters of recommendation from both the research and academic advisor that states that they agree to serve in these roles and that they support the BS/MS application.

2. The BME department does not guarantee financial support during the MS portion of this program. However, the GEC requires students and potential research advisors to discuss and agree to some financial arrangement. The letter of recommendation from the proposed research advisor must therefore indicate that the issue of financial support has been discussed and that some arrangement has been agreed upon. The details of this arrangement do not need to be included in the letter.

3. Complete a standard application to the School of Graduate Studies via the online application system.

4. Complete the BS/MS Planned Program of Study (PPOS) form (in Appendix VI or from the BME web site bme.case.edu). Make sure to check the "BS/MS" box and to indicate which courses are to be double-counted (by checking the "double count" box next to the relevant courses on the POS).

5. Obtain an approval signature from the School of Undergraduate Studies on the proposed POS prior to submitting the package (below) to the department.

6. Prepare the application package that includes the following:

   - A current transcript
   - The proposed M.S. Program of Study. Make sure that the Program of Study specifies both the academic and research advisors and includes both of their signatures. This form also needs to indicate the courses that are intended to be "double counted".
   - Only graduate-level courses (400 or higher) can be double counted. This typically means that students should register for 400 level courses to satisfy undergraduate technical electives.
   - It is possible to "double count" three credit hours of EBME 398. To do this, three credit hours of EBME 651 (Thesis Option) or EBME 601 (Non-Thesis Option) should replace EBME 398 in the fall or spring of the senior year. You should register for EBME 651 or EBME 601 (but NOT EMBE 398). However, you must attend the meetings of EBME 398 and also fulfill all of the course requirements for EBME 398.
   - A maximum of nine (9) credit hrs can be double counted. Typically, these are two 3-credit courses (400 level or high) + 3 credits of EBME 651 or EBME 601 (in place of EBME 398).
   - Three (3) reference reports (in sealed envelopes), including letters from your proposed academic and research advisor(s).

1. Submit the proposed POS, transcript, and letters of recommendation to the BME Graduate Coordinator.

No admission decision will be made until the POS is approved by the GEC. After a positive recommendation by the GEC, a letter of conditional admission will be sent. The condition for admission is the submission of GRE scores within 2 months of the completing the B.S. requirements. The student cannot graduate from the B.S./M.S. program without official GRE scores. This is a BME requirement and not a CSE requirement. Note that it is strongly recommended that students plan to take the GRE exam in the Fall semester of their senior year to be eligible for pre-doctoral fellowships from the National Science Foundation or other sources.

**BS-MS Thesis Option**

18 hrs of course work and 9-hrs of EBME651

Requirement for completion: 27 hours and thesis defense

/schoolofgraduatestudies/academicrequirements/ (p. 1045)

Students can double count 3 courses (must be at the graduate level)

**BS-MS Non-Thesis Options**

1. BS-MS Course Only Option

27-hrs of course work

Requirement for Completion: 27hrs and comprehensive examination

Students can double-count 3 courses (must be at the graduate level)

2. BS-MS Project Option

24-hrs of course work and 3-hrs of EBME601

Students Can double-count 3 courses (must be at the graduate level)

3. BS-ME Practice Oriented Option

18 hrs in engineering (5 courses and a capstone projects)

EPOM 400: Engineering Professionalism

EPOM 401: Introduction to Business for Engineers

EPOM 403: Product and Process Design

EPOM 405: Applied Engineering Statistics (can be double-counted)

EPOM 407: Engineering Economics and Financial Analysis

EPOM 409: Master of Engineering Capstone Project

9 hrs (3 BME technical Courses)

Graduation requirement: 27 hrs and a comprehensive examination

Students can double-count 3 courses (only one at the undergraduate level)
**Minor in Biomedical Engineering**

A minor in biomedical engineering is offered to students who have taken the Engineering (technical) Core requirements. The minor consists of an approved set of five EBME courses.

**Required Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBME 201</td>
<td>Physiology-Biophysics I</td>
<td>3</td>
</tr>
<tr>
<td>EBME 202</td>
<td>Physiology-Biophysics II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elect three of the following with at least one from the BME core *(assumes prerequisites satisfied):</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EBME 306 Introduction to Biomedical Materials</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 308/358 Biomedical Signals and Systems **</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 309/359 Principles of Biomedical Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 310/360 Structure of Biological Materials</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 303 Materials for Prosthetics and Orthotics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 305 Biomechanical Prosthetic Systems</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 316 Biomaterials for Drug Delivery</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 320 Medical Imaging Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 325 Introduction to Tissue Engineering</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 327 Bioelectric Engineering</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 350 Quantitative Molecular, Cellular and Tissue Bioengineering</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EBME 361 Biomedical Image Processing and Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units 15

*EBME 306, 308/358, 309/359, 310/360

** If a student has credit for EECS 246 Signals and Systems, EBME 308/258 will not satisfy a BME minor requirement

**Graduate Programs**

The objective of the graduate program in biomedical engineering is to educate biomedical engineers for careers in industry, academia, health care, and government and to advance research in biomedical engineering. The department provides a learning environment that encourages students to apply biomedical engineering methods to advance basic scientific discovery; integrate knowledge across the spectrum from basic cellular and molecular biology through tissue, organ, and whole-body physiology and pathophysiology; and to exploit this knowledge to design diagnostic and therapeutic technologies that improve human health. The unique and rich medical, science, and engineering environment at Case enables research projects ranging from basic science through engineering design and clinical application.

Numerous fellowships and research assistantships are available to support graduate students in their studies.

**Master of Science in Engineering**

The MS program in biomedical engineering provides breadth in biomedical engineering and biomedical sciences with depth in an engineering specialty. In addition, students are expected to develop the ability to work independently on a biomedical research or design project. While there is no set of core required courses, the MS requires a minimum of 27 credit hours. Every program of study must be approved by the graduate education committee. With an MS research thesis (Plan A), a minimum of 18 credits is needed in regular course work and 9 hours of thesis research (EBME 651 Thesis M.S.). With an MS project (Plan B), a minimum of 24 credits is needed in regular course work, and three hours of project research (EBME 601 Research Projects); or this can be accomplished in 27 credit hours of coursework with a comprehensive final exam for the degree. The Master of Science in Biomedical Engineering degree is also available exclusively online. Visit http://online-engineering.case.edu/biomedical for more details.

**Master of Science in Engineering with Specialization Translational Health Technology**

This Masters degree in Biomedical Engineering is designed to develop expertise in translating biomedical ideas into clinical implementation. This degree can be completed in one year for full time students. It is offered by the Biomedical Engineering department in the Case School of Engineering, and takes advantage of the large pool of expertise in Biotechnology on the campus of Case Western Reserve University. It combines aspects of bioengineering, marketing, entrepreneurship, and bioregulatory affairs with ethics and experimental design. The program will require students to take a minimum of 27 credits including a design project. Visit http://engineering.case.edu/Translational-Health-Technology/program-features

**Prerequisite:** Biomedical Engineering Degree or equivalent or consent of program director.

**Special Features:**

- Eight courses plus 4 hours of project
- Portions available through Distance Learning
- Flexible program to accommodate a professional’s schedule
- Lock-Step Program; Duration 1 year: August to August
- Projects can be done within the place of work

**Wireless Health**

The MS degree in Biomedical Engineering (BME) with a specialization in Wireless Health is a “course-only” program of study. Students who complete the 3-course, 27-credit course-only option will have the requisite knowledge to enter and advance the wireless health industry.

For more details, please refer to the Master's Degree (http://engineering.case.edu/sandiego/ms) information on the Case School of Engineering - San Diego website.

**MD/MS Program**

The MD/MS program is available to qualified medical students from the Case School of Medicine and the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University. Students in this program receive some credit for their medical school studies in completing the MS degree. There are specific admission requirements.

The MD/MS degree is open to Case School of Medicine students in the Cleveland Clinic Lerner College of Medicine (CCLCM) or the University Program (UP), which will award the MD component of the dual degree. An undergraduate degree in engineering is desirable for students entering this program, but other students with an adequate undergraduate preparation (calculus with differential equations, physics, chemistry, and electronic circuits) will be considered. Additional undergraduate courses in instrumentation and signals/systems would be helpful. Students with an insufficient background will be admitted conditionally until they take
the remedial undergraduate courses. Remedial courses will not count toward the MS requirements.

Interested students should submit their applications through the BME department, as the department taking responsibility for program management. Students will normally apply to the 10 program during their first year of medical school. Students should submit their medical school application instead of a separate graduate school application, including MCAT scores instead of GRE scores. The application should include a letter specifying the intended track, the department/major field designation, and a statement of purpose for seeking the combined degree.

The MS requirements are the same as the rest of the Case School of Engineering Thesis Option MS degree, i.e., 27 credit hours including nine hours of thesis registration (EBME 651). Please note that only Thesis Option is available to MS/MD students. Students must complete the normal MD requirements in either the UP or CCLCM program. Portions of the medical school curriculum earn graded credit toward the MS portion of this degree. Specifically, students in the University Program register for Integrated Biological Science courses (IBIS 401-405), as in the MD/PhD program. Students in the CCLCM Program enroll in the 6-credit IBIS 434 Process of Discovery course in the second year of the CCLCM curriculum. Six credit hours of these medical school courses are applied to the MS component of the dual degree. The balance of required formal courses (12 hours or 4 courses) must be graduate level engineering concentration courses that provide rigor and depth in a field of engineering relevant to the area of research. All courses must be listed on the BME Program of Study, which must be submitted and formally approved by the BME Graduate Education Committee and subsequently transmitted to the School of Graduate Studies. The Program of Study must be approved prior to registration for the second engineering course. Students must earn a minimum of a B grade in each graduate engineering course, and have a minimum overall GPA of 3.25.

Summary of the requirements
6 hrs Life science courses (medical school curriculum)
12 hrs (4 courses) in biomedical engineering
9 hrs of thesis research (EBME 651)
Graduation requirement: 27 hrs, Thesis defense

http://engineering.case.edu/ebme/academics/graduate/current-students

For more detailed information on this program, please see

http://casemed.case.edu/admissions/education/dual_programs.cfm?program_id=11

**PhD Program in Biomedical Engineering**

The PhD program requires a minimum of 36 credit hours of courses beyond the BS degree. A student's overall Program of Study must clearly demonstrate adequate depth in a field of biomedical engineering relevant to the student's research area. There are 12 credit hours of required core courses, which include the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBME 401D</td>
<td>Biomedical Instrumentation and Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EBME 432</td>
<td>Quantitative Analysis of Physiological Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

The remaining courses can be chosen with significant flexibility to meet the career goals of the student, and to satisfy the departmental requirements of depth and breadth. Programs of Study must include one graduate level course in biomedical sciences and one course whose content is primarily mathematical, in addition to at least two courses with significant engineering content. More details on these requirements and accepted depth and breadth courses can be found in the Department of Biomedical Engineering's Graduate Education Committee Handbook. Eighteen hours of EBME 701: Dissertation PhD are also required. PhD programs of study are reviewed and must be accepted by the Graduate Education Committee, the department chair and the School of Graduate Studies.

**MD/PhD Programs**

Students with outstanding qualifications may apply to either of two MD/PhD programs. Students interested in obtaining a combined MD/PhD, with an emphasis on basic research in biomedical engineering, are strongly encouraged to explore the Medical Scientist Training Program (MSTP), administered by the School of Medicine. The MD/PhD programs require approximately 7-8 years of intensive study after the BS Interested students should apply through the MSTP office in the Medical School.

**Graduate Certificate**

Graduate Certificates are discipline independent and intended to enable knowledgeable entry into the field of study. They are prescribed 3-course, 9-credit subsets of our MS degree offerings.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBME/ECECS 480A</td>
<td>Introduction to Wireless Health</td>
<td>3</td>
</tr>
<tr>
<td>EBME/ECECS 480B</td>
<td>The Human Body</td>
<td>3</td>
</tr>
</tbody>
</table>
Facilities

The Department of Biomedical Engineering has major facilities in both the Case School of Engineering and the School of Medicine. In the Case School of Engineering, the Wickenden Building provides office space for the majority of faculty, as well as extensive non-clinical research laboratories and centers. Also, a number of faculty have their offices and laboratories in the School of Medicine in the Biomedical Research Building and the Wolstein Building. In addition, many faculty also have major laboratory activities in the various medical centers in Cleveland.

Major interdisciplinary centers include: the Neural Engineering Center, the Case Center for Imaging Research (CCIR), the Center for Biomaterials, and the Center for Computational Imaging & Personalized Diagnostics. The Neural Engineering Center is a major facility for basic research and preclinical testing, with a focus on neural recording and controlling neural activity to increase our understanding of the nervous system and to develop neural prostheses. The Case Center for Imaging Research is located in the Department of Radiology at University Hospitals, has capabilities in imaging structure and function from the molecular level to the tissue-organ level, using many modalities, including ultrasound, MRI, CT, PET, SPECT, bioluminescence, and light. The CCIR has the ability for full translation of discoveries along a continuum from molecules to mice to man. The Center for Biomaterials includes laboratories for biomaterials microscopy, biopolymer and biomaterial interfaces, and molecular simulation. The Center for Computational Imaging & Personalized Diagnostics develops, evaluates, and applies novel quantitative image analysis, computer vision, signal processing, segmentation, multi-modal co-registration tools, pattern recognition, and machine learning tools for disease diagnosis, prognosis, and theragnosis in the context of breast, lung, prostate, head and neck, and brain tumors. The center is also developing new radiogenomic and radio-path-omic approaches to study correlations of disease markers across multiple length scales, modalities, and functionalities - from gene and protein expression to spectroscopy to digital pathology and to multi-parametric radiographic imaging. Also available are biomedical sensing laboratories that include facilities for electrochemical sensing, chemical measurements in individual cells, and minimally invasive physiological monitoring. High-fidelity patient simulation and clinical decision-making research are done in collaboration with the School of Nursing’s simulation center.

The FES (Functional Electrical Stimulation) Center, with laboratories at CWRU and in three medical centers, develops techniques for restoration of movement in paralysis, control of the nervous system, and implantable technology. The APT (Advanced Platform Technology) Center develops advanced technologies that serve the clinical needs of veterans and others with motor and sensory deficits, limb loss, and other disabilities.

The Case-Coulter Translational Research Partnership (CCTR P) is an endowed program that promotes translational research and supports collaborative translational research projects to address unmet or poorly met clinical needs. The overarching goal of the program is to improve patient care and accelerate the delivery of healthcare technology from academia to the marketplace. The CCTRP, in particular, fosters collaborations between clinicians and the CWRU Biomedical Engineering faculty to achieve its goals.

The Biomedical Engineering faculty and students have access to the many facilities and major laboratories of both the Case School of Engineering and School of Medicine. In addition, faculty have numerous collaborations at University Hospitals, MetroHealth Medical Center, Louis Stokes Cleveland VA Medical Center, and the Cleveland Clinic. These provide extensive research resources in a clinical environment for both undergraduate and graduate students.

Primary Appointments

Robert F. Kirsch, PhD
(Northwestern University)
Professor and Chair; Executive Director, Functional Electrical Stimulation Center

A. Bolu Ajiboye, PhD
(Northwestern University)
Assistant Professor
Development and control of brain-computer-interface (BCI) technologies for restoring function to individuals with nervous system injuries

Eben Alsberg, PhD
(University of Michigan)
Professor
Biomimetic tissue engineering; innovative biomaterials and drug delivery vehicles for functional tissue regeneration and cancer therapy; control of stem cell fate decision; precise temporal and spatial presentation of signals to regulate cell behavior; mechanotransduction and the influence of mechanics on cell behavior and tissue formation; and cell-cell interactions

James M. Anderson, MD (Case Western Reserve University), PhD (Oregon State University)
Professor of Pathology, Macromolecular Science and Biomedical Engineering; Distinguished University Professor
Blood and tissue/material interactions as they relate to implantable devices and biomaterials

James P. Basilion, PhD
(The University of Texas)
Professor (joint with Radiology)
High resolution imaging of endogenous gene expression; definition of "molecular signatures" for imaging and treatment of cancer and other diseases; generating and utilizing genomic data to define informative targets; strategies for applying non-invasive imaging to drug development; and novel molecular imaging probes and paradigms

Jeffrey Capadona, PhD
(Georgia Institute of Technology)
Associate Professor
Advanced materials for neural interfacing; biomimetic and bio-inspired materials; host-implant integration; anti-inflammatory materials; and novel biomaterials for surface modification of cortical neuroprostheses
Patrick E. Crago, PhD  
(Case Western Reserve University)  
Emeritus Professor  
Control of neuroprostheses for restoration of motor function;  
neuromechanics; and modeling of neuromusculoskeletal systems

Colin Drummond, PhD (Syracuse University), MBA (Case Western Reserve University)  
Professor and Assistant Chair  
Medical device design, microfabrication packaging, sensor systems, and  
cross-platform software systems integration

Jeffrey L. Duerk, PhD  
(Case Western Reserve University)  
Dean, Case School of Engineering; Leonard Case Professor of Engineering;  
Director, Case Center for Imaging Research  
Magnetic resonance imaging; rapid magnetic resonance imaging pulse  
sequence development; image reconstruction from non-rectilinearly  
sampled data; the development of image-guided interventional MRI  
procedures, including percutaneous cancer and cardiovascular  
procedures

Dominique M. Durand, PhD  
(University of Toronto, Canada)  
Elmer Lincoln Lindseth Professor in Biomedical Engineering; Director, Neural  
Engineering Center  
Neural engineering; neural interfacing; neural prostheses; computational  
nervous science; neural dynamics; neuromodulation; neurophysiology and  
control of epilepsy

Steven J. Eppell, PhD  
(Case Western Reserve University)  
Associate Professor  
Biomaterials; instrumentation; nanoscale structure-function analysis  
of orthopaedic biomaterials; and scanning probe microscopy and  
spectroscopy of skeletal tissues

Miklos Gratzl, PhD  
(Technical University of Budapest, Hungary)  
Associate Professor  
Biomedical sensing and diagnostics in vitro and in vivo; electrochemical  
and optical techniques; BioMEMS for cellular transport; cancer multi-  
drug resistance at the single cell level; and sliver sensor for multi-analyte  
patient monitoring

Kenneth Gustafson, PhD  
(Arizona State University)  
Associate Professor  
Neural engineering; neural prostheses; neurophysiology and neural  
control of genitourinary function; devices to restore genitourinary  
function; and functional neuromuscular stimulation

Efstathios (Stathis) Karathanasis, PhD  
(University of Houston)  
Associate Professor  
Fabricating multifunctional agents that facilitate diagnosing; treating and  
monitoring of therapies in a patient-specific manner

Zheng-Rong Lu, PhD  
(Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences)  
M. Frank and Margaret Domiter Rudy Professor of Biomedical Engineering  
Drug delivery and molecular imaging; novel targeted imaging agents for  
molecular imaging; novel MRI contrast agents; image-guided therapy and  
drug delivery; polymeric drug delivery systems; multi-functional delivery  
systems for nucleic acids

Anant Madabhushi, PhD  
(Rutgers University)  
F. Alex Nason Professor II  
Quantitative image analysis; Multi-modal, multi-scale correlation of  
massive data sets for disease diagnostics, prognostics, theragnostics;  
cancer applications

Cameron McIntyre, PhD  
(Case Western Reserve University)  
Professor, Molecular Medicine  
Theoretical modeling of the interaction between electric fields and the  
nervous system; deep brain stimulation

J. Thomas Mortimer, PhD  
(Case Western Reserve University)  
Professor Emeritus  
Neural control and prostheses; electrical activation of neural tissue; and  
membrane properties and electrodes

P. Hunter Peckham, PhD  
(Case Western Reserve University)  
Donnell Institute Professor; Distinguished University Professor;  
Rehabilitation engineering in spinal cord injury; neural prostheses; and  
functional electrical stimulation and technology transfer

Andrew M. Rollins, PhD  
(Case Western Reserve University)  
Professor  
Biomedical optics; real-time in-vivo microstructural, functional, and  
molecular imaging using optical coherence tomography; diagnosis and  
guided therapy for cancer, cardiovascular, and ophthalmic disease

Gerald M. Saidel, PhD  
(The Johns Hopkins University)  
Professor; Director, Center for Modeling Integrated Metabolic Systems  
Mass and heat transport and metabolism in cells, tissues, and organ  
systems; mathematical modeling and simulation of dynamic and  
spatially distributed systems; optimal nonlinear parameter estimation  
and design of experiments

Nicole Seiberlich, PhD  
(University of Wurzburg)  
Elmer Lincoln Lindseth Associate Professor in Biomedical Engineering  
Advanced signal processing and data acquisition techniques for rapid  
Magnetic Resonance Imaging (MRI).

Anirban Sen Gupta, PhD  
(The University of Akron)  
Associate Professor  
Targeted drug delivery; targeted molecular imaging; image-guided  
therapy; platelet substitutes; novel polymeric biomaterials for tissue  
engineering scaffolds
Secondary Appointments

Sam Senyo, PhD  
(University of Illinois)  
Assistant Professor  
Cardiovascular regeneration; microenvironment; stable isotopes; biomaterials, microfabrication; and drug delivery

Nicole F. Steinmetz, PhD  
(John Innes Centre in Norwich, UK)  
Associate Professor  
Engineering of viral nanoparticles as smart devices for applications in medicine: tissue-specific imaging, drug-delivery, and tissue engineering

Pallavi Tiwari, PhD  
(Rutgers University)  
Assistant Professor  

Ronald J. Triolo, PhD  
(Drexel University)  
Associate Professor, Orthopaedics, University Hospitals-Case Medical Center, VA Medical Center, MetroHealth Medical Center  
Neural prostheses, rehabilitation engineering and restoration of lower extremity function, biomechanics of human movement quantitative analysis and control of gait, standing balance and seated posture

Dustin J. Tyler, PhD  
(Case Western Reserve University)  
Kent Hale Smith Professor for the Case School of Engineering II  
Neuromimetic neuroprostheses; laryngeal neuroprostheses; clinical implementation of nerve electrodes, cortical neuroprostheses; minimally invasive implantation techniques; and modeling of neural stimulation and neuroprostheses

Horst A. von Recum, PhD  
(University of Utah)  
Affinity-based delivery of small molecule drugs and biomolecules for applications in device infection, HIV, orthopedics, cardiovascular, ophthalmology and cancer; directed differentiation of stem cells for tissue engineering applications, such as endothelial cells, cardiomyocytes, motor neurons and T-cells

Satish Viswanath, PhD  
(Rutgers University)  
Assistant Professor  
Medical image analysis, image radiomics, and machine learning schemes, focused on the use of post-processing, co-registration, and biological quantitation; with applications in image-guided interventions, directed guidance, and quantitative evaluation of response to treatment in gastrointestinal cancers and inflammatory diseases

David L. Wilson, PhD  
(Rice University)  
Robert J. Herbold Professor  
Biomedical image processing; digital processing and quantitative image quality of X-ray fluoroscopy images; interventional MRI

Xin Yu, ScD  
(Harvard-MIT)  
Professor  
Magnetic resonance imaging and spectroscopy; applications of MRI and MRS to cardiovascular research

Secondary Appointments

Rigoberto Advincula, PhD  
(University of Florida)  
Professor, Macromolecular Science & Engineering  
Design, synthesis, and characterization of polymers and nanostructured materials capable of controlled-assembly, tethering, and self-organization in ultrathin films.

Ozan Akkus, PhD  
(Case Western Reserve)  
Associate Professor, Mechanical Aerospace Engineering  
Development of novel biomaterials that sill substitute bone and soft tissues, bioinspired from the synthesis of bone such that ductile biocompatible polmer mats are subjected to mineralization. Tendon replacement strategy involve alignent of collagen monomers by a novel electrochemical method to obtain strong bundles.

Jay Alberts, PhD  
(Arizona State University)  
Assistant Professor, Molecular Medicine, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)  
Neural basis of upper extremity motor function and deep brain stimulation in Parkinson’s disease

Harihara Baskaran, PhD  
(Pennsylvania State University)  
Associate Professor, Chemical and Biomolecular Engineering  
Design and build microvascular flow analogs that can be used to overcome nutrient limitations in tissue-engineered products

Jonathan Baskin, MD  
(New York University)  
Assistant Professor, Chief, Otolaryngology-Head & Neck Surgery, University Hospitals-Case Medical Center, VA Medical Center  
Bioengineering of bone substitutes using nanotechnology

Arnold Caplan, PhD  
(Johns Hopkins University)  
Professor, Biology  
Develop and refine the technology necessary to isolate one of these rare stem cells, the mesenchymal stem cell (MSC)

M. Cenk Cavusoglu, PhD  
(University of California, Berkeley)  
Professor, Electrical Engineering & Computer Science  
Robotics, systems and control theory, and human-machine interfaces; with emphasis on medical robotics, haptics, virtual environments, surgical simulation, and bio-system modeling and simulation

John Chae, MD  
(New Jersey Medical School)  
Professor, Physical Medicine and Rehabilitation, MetroHealth Medical Center  
Stroke rehabilitation, neuromuscular electrical stimulation to restore upper and lower extremity function after stroke

Hillel J. Chiel, PhD  
(Massachusetts Institute of Technology)  
Professor, Biology  
Biomechanical and neural basis of feeding behavior in the marine mollusk Aplysia californica; neuromechanical system modeling; analysis of neural network dynamics
Margot Damaser, PhD  
(University of California)  
Professor, Molecular Medicine, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)  
Biomechanics and neural control of the female pelvic floor and lower urinary tract in normal and dysfunctional cases

Kathleen Derwin, PhD  
(University of Michigan)  
Assistant Professor, Molecular Medicine, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)  
Tendon mechanobiology and tissue engineering

Isabelle Deschenes, PhD  
(Laval University)  
Assistant Professor, Cardiology, MetroHealth Medical Center  
Molecular mechanisms of cardiac arrhythmias, ion channels structure-function

Agata Exner, PhD  
(Case Western Reserve University)  
Professor, Radiology, University Hospitals-Case Medical Center  
Development and imaging characterization of drug delivery for cancer chemotherapy; interventional radiology

Christopher Flask, PhD  
(Case Western Reserve University)  
Associate Professor, Radiology, University Hospitals-Case Medical Center  
Development of Quantitative and Molecular MRI Imaging Methods, MRI Physics

Roger French, PhD  
(Massachusetts Institute of Technology)  
Director, SDLE Center, Professor Materials Science, Macromolecular, Physics  
Collaborates with Dr. Steinmetz on long range interactions in biomolecular and inorganic materials

Kiyotaka Fukamachi, MD, PhD  
(Kyushu University)  
Professor, Molecular Medicine, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)  
Research activities entail promoting human health through the development of various surgical treatments for heart failure, encompassing a broad range of options

Linda M. Graham, MD  
(University of Michigan)  
Professor, Surgery, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)  
Cell movement and vascular healing, vascular tissue engineering

Mark Griswold, PhD  
(University of Wuerzburg, Germany)  
Professor, Radiology, University Hospitals-Case Medical Center  
Rapid magnetic resonance imaging, image reconstruction and processing and MRI hardware/instrumentation

Vikas Gulani, MD, PhD  
(University of Illinois)  
Associate Professor, Radiology, University Hospitals-Case Medical Center  
Diffusion tensor imaging and diffusion anisotropy, MRI microscopy, body MRI, and functional MRI

Umut A Gurkan, PhD  
(Purdue University)  
Assistant Professor, Mechanical and Aerospace Engineering, Orthopaedics  
Micro/nano engineered systems and biomedical technologies. Student mentoring

Alex Y. Huang, MD, PhD  
(Johns Hopkins University)  
Associate Professor, Pediatrics, Pathology, University Hospitals-Case Medical Center/Rainbow Babies and Children's Hospital  
Study various aspects of anti-tumor immune responses, immune – host – pathogen interaction, T cell-mediated memory immunity, and chemokine-receptor biology

Michael Jenkins, PhD  
(Case Western Reserve University)  
Assistant Professor, Pediatrics, Biomedical Engineering  
Biomedical imaging and instrumentation to determine congenital heart defects. Collaborates with BME faculty.

Michael W. Keith, MD  
(Ohio State University)  
Professor, Orthopaedic Surgery, MetroHealth Medical Center  
Restoration of motor function in hands

Kandice Kottke-Marchant, MD, PhD  
(Case Western Reserve University)  
Professor and Chair, Molecular Medicine, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)  
Thrombosis, hemostasis and vascular disease, hypercoagulable states, bleeding disorders, endothelial cell function, atherosclerosis

Vinod Labhasetwar, PhD  
(Nagpur University, India)  
Professor, Molecular Medicine, Cleveland Clinic Lerner College of Medicine (Lerner Research Institute)  
Cancer treatment and detection, delivery of anti-oxidant enzymes in stroke and development of a non-stent approach to inhibition of restenosis

Kenneth R. Laurita, PhD  
(Case Western Reserve University)  
Associate Professor, Heart and Vascular Research Center, MetroHealth Medical Center  
Cellular mechanisms of cardiac arrhythmias using fluorescent imaging of transmembrane potential and intracellular calcium in the intact heart

Zhenghong Lee, PhD  
(Case Western Reserve University)  
Professor, Radiology, Nuclear Medicine, University Hospitals-Case Medical Center  
Quantitative PET and SPECT imaging, multimodal image registration, 3D visualization, molecular imaging and small animal imaging systems

Kenneth Loparo, PhD  
(Case Western Reserve University)  
Nord Professor of Engineering, Electrical Engineering & Computer Science  
Stability and control of nonlinear and stochastic systems; systems biology
Mehran Mehregany, PhD  
(Massachusetts Institute of Technology)  
Professor, Electrical Engineering & Computer Science  
Micro/Nano-Electro-Mechanical Systems; silicon carbide semiconductor  
technology and microsystems; wireless health

Pedram Mohseni, PhD  
(University of Michigan)  
Associate Professor, Electrical Engineering & Computer Science  
Biomicrosystems; biomedical microtelemetry; biological-electronic  
interfaces; microelectronics for neurotechnology; and wireless integrated  
sensing/actuating systems

George F. Muschler, MD  
(Northwestern University)  
Professor, Molecular Medicine (Orthopaedic Surgery and Biomedical  
Engineering, Cleveland Clinic)  
Bone biology, skeletal reconstruction, aging and osteoporosis

Raymond F. Muzic Jr., PhD  
(Case Western Reserve University)  
Professor, Radiology, Biomedical Engineering, Oncology, Division of General  
Medical Sciences, University Hospitals-Case Medical Center  
Quantitative analysis of biomedical imaging data, physiologic modeling,  
optimal experiment design, assessment of new radiopharmaceuticals,  
imaging response to therapy, and in vivo quantification of receptor  
concentration

Ela Plow, PhD PT  
(University of Minnesota)  
Assistant Professor, Cleveland Clinic Lerner College of Medicine (Lerner  
Research Institute)  
Neurological recovery in clinical rehabilitation. Neural mechanisms of  
Functional Electrical Stimulation (FES)-based rehabilitative technique.  
Tailored brain stimulation, tailored rehabilitation, patient specific  
treatments, functional neuroimaging, Transcranial Magnetic Stimulation  
(TMS), Transcranial Direct Current Stimulation (TDCS), Diffusion Tensor  
Imaging (DTI)

Tarun Podder, PhD  
(University of Hawaii)  
Associate Professor, Radiation Oncology  
Student mentoring and collaborates with BME faculty.

Anand Ramamurthi, PhD  
(Oklahoma State University)  
Associate Professor, Molecular Medicine, Cleveland Clinic Lerner College of  
Medicine (Lerner Research Institute)  
Artificial heart valves, tissue engineering, biomaterials, thrombosis

Clare Rimnac, PhD  
(Lehigh University)  
Professor, Mechanical and Aerospace Engineering  
Orthopaedic implant performance and design, mechanical behavior of  
hard tissues

Mark S. Rzeszotarski, PhD  
(Case Western Reserve University)  
Professor, Radiology, MetroHealth Medical Center  
Radiological imaging; computed tomography, medical education

Dawn Taylor, PhD  
(Arizona State University)  
Associate Professor, Molecular Medicine, Cleveland Clinic Lerner College of  
Medicine (Lerner Research Institute)  
Restoration of movement and function to paralysis victims through the  
application of electrical current to the peripheral nerves

Jeffrey Ustin, MD  
(Stanford University School of Medicine)  
Assistant Professor, Anesthesiology, University Hospitals

Jennell Vick, PhD  
(University of Washington, Seattle)  
Assistant Professor, Communication Sciences, Pediatrics, Biomedical  
Engineering  
Motor control, collaboration with faculty and student mentoring.

Albert L. Waldo, MD  
(University of Notre Dame)  
Professor, Radiation Oncology, Director, Division of Medical Physics and  
Dosimetry, University Hospitals-Case Medical Center  
Cardiac electrophysiology and cardiac excitation mapping

Benjamin Walter, MD  
(MCP-Hahnemann School of Medicine, Philadelphia)  
Associate Professor, Neurology.  
Neuromodulation with deep brain stimulation, student committee  
member and advisor.

Russell Wang, DDS, MSD  
(Indiana University)  
Associate Professor, Comprehensive Care, School of Dental Medicine  
Dental implant design, instrumentation, bone regeneration, 3D printing  
of biomaterials, biomechanics of bone fracture, biomaterials for  
maxillofacial reconstruction

Barry Wessels, PhD  
(University of Notre Dame)  
Professor, Radiation Oncology; Director, Division of Medical Physics and  
Dosimetry, University Hospitals-Case Medical Center  
Radiolabeled antibody therapy (Dosimetry and clinical trials), image-  
guided radiotherapy, intensity modulated radiation therapy, image fusion  
of CT, MR, SPECT and PET for adaptive radiation therapy treatment  
planning

Gary Wnek, PhD  
(University of Massachusetts, Amherst)  
Professor, Macromolecular Science and Engineering, Biomedical Engineering  
Synthetic mimics of nerve, collagen solvent processing and drug delivery  
from polymer fibers. Collaboration with BME faculty

Xiong Yu, PhD, P.E.  
(Purdue University School of Civil Engineering)  
Associate Professor, Civil Engineering  
Materials and sensors innovations with emphasis on interdisciplinary  
innovation to improve intelligent and durability

Maciej Zborowski, PhD  
(Polish Academy of Science)  
Associate Professor, Molecular Medicine, Cleveland Clinic Lerner College of  
Medicine (Lerner Research Institute)  
Membrane separation of blood proteins
Nicholas P. Ziats, PhD  
(Case Western Reserve University)  
*Professor, Pathology, University Hospitals-Case Medical Center*  
Vascular grafts; vascular cells; blood vessels

Christian Zorman, PhD  
(Case Western Reserve University)  
*Associate Professor, Electrical Engineering & Computer Science*  
Development of enabling materials for micro- and nanosystems

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**Research Appointments**

Musa L. Audu, PhD  
(Case Western Reserve University)  
*Research Associate Professor*  
Human musculoskeletal modeling and development of control systems for rehabilitation of individuals with spinal cord injury and other balance disorders. Design of rehabilitation devices for physically challenged individuals.

Niloy Bhadra, MD, PhD  
(Case Western Reserve University)  
*Research Assistant Professor*  
Experimental and computational studies of high frequency waveforms for reversible conduction block of peripheral nerves; design, testing and implementation of neuroprosthetic systems for the upper limb.

Pubudu Peiris, PhD  
(Cleveland State University)  
*Research Assistant Professor*  
Development of impactful therapeutic and diagnostic agents for hard to treat and lethal forms of cancer.

Sourabh Shukla, PhD  
(University of Pune)  
*Research Assistant Professor*  
Bio-inspired nanotechnology toward the development of innovative cancer therapeutic strategies.

Tina Vrabec, PhD  
(Case Western Reserve University)  
*Research Assistant Professor*  
Novel waveforms, electrode designs, and electrode materials for control of the nervous system as applied to motor block, pain, and the autonomic system.

Ethan Walker, MD, PhD  
(National Medical University; Institute of Tuberculosis & Pulmonology of the Academy of Medical Science of Ukraine)  
*Research Assistant Professor*  
Development of a live-time imaging technique to rapidly and reliably identify basal and squamous skin cancer in the margins of conventionally resected skin cancer samples that would significantly impact the quality of patient care.

Xinning Wang, PhD  
(The Chinese University of Hong Kong)  
*Research Assistant Professor*  
Development of novel molecular image probes for the diagnosis of cancer; development of molecular cancer therapeutic approaches.

Mei Zhang, PhD  
(Wuhan University)  
*Research Assistant Professor*  
Nanotechnology for Cancer Diagnosis and Treatment; Imaging and Manipulation of Tumor Microenvironment; Cancer Immunotherapy; Adoptive T cell Immunotherapy.

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**Adjunct Faculty**

Kath Bogie, D. Phil  
(University of Oxford)  
*Adjunct Assistant Professor, Biomedical Engineering (VA Medical Center)*  
Wound prevention and treatment in individuals with paralysis and in the biomechanics of wheelchairs and seating for people with limited mobility

Michael Bruckman, PhD  
(University of South Carolina)  
*Adjunct Assistant Professor*  
Engineering viral nanoparticles for MRI detection of atherosclerosis in mice

Scott Bruder, MD, PhD  
(Case Western Reserve University)  
*Adjunct Professor*  
Advises MD/PhD students regarding careers in industry.

Richard C. Burgess, MD, PhD  
(Case Western Reserve University)  
*Adjunct Professor of Biomedical Engineering (Neurological Computing, Cleveland Clinic)*  
Magnetoencephalography; Electrophysiological monitoring; EEG processing; medical informatics

Andrew Cornwell, PhD  
(Case Western Reserve University)  
*Adjunct Assistant Professor*  
Electrical stimulation of the nervous system, especially for use in rehabilitation of neurological disorders.

J. Kevin Donahue, MD  
(Washington University)  
*Adjunct Professor (University of Massachusetts)*  
Arrhythmia ablation; atrial fibrillation; cardiac arrhythmia; gene therapy; implantable cardioverter defibrillator; myocardial infarction; ventricular tachycardia

William J. Dupps, MD, PhD  
(The Ohio State University)  
*Adjunct Associate Professor (Cole Eye Institute and Biomedical Engineering, Cleveland Clinic)*  
Application of engineering tools to the diagnosis and management of biomechanical disorders such as keratoconus and glaucoma

Stephen Fening, PhD  
(Ohio University)  
*Adjunct Associate Professor*  
patient care through translational research and commercialization
Jennifer Greene-Roos, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor (Cleveland Cord Blood Center)  
Umbilical cord monocytes for non-healing wounds and gene therapy to treat HIV infected lymphoma patients. Collaboration with faculty and student mentoring.

Elizabeth C. Hardin, PhD  
(University of Massachusetts)  
Adjunct Associate Professor of Biomedical Engineering, (VA Medical Center)  
Neural prostheses and gait mechanics; improving gait performance with neural prostheses using strategies developed in conjunction with forward dynamics musculoskeletal models

Thomas Hering, PhD  
(Case Western Reserve University)  
Adjunct Associate Professor (Orthopaedic Surgery, Washington University)  
Cartilage; extracellular matrix biochemistry and molecular biology; transcriptional regulation of chondrogenesis

Joseph Jankowski, PhD, MBA  
(Case Western Reserve University)  
Adjunct Professor  
Administration of multi-party translation and commercialization programs, interacts with students and faculty who partake in the interdisciplinary curriculum in the fields of intellectual property management, technology-based opportunity assessment, and commercialization

Kevin L. Kilgore, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor, Biomedical Engineering, Orthopaedics, (MetroHealth Medical Center)  
Functional electrical stimulation; neuroprostheses

Nicola Lai, PhD  
(University of Pisa, Italy)  
Adjunct Associate Professor (Old Dominion University)  
Quantitative understanding of regulation of energy transfer and metabolism. Collaboration with faculty and student committee member.

William Landis, PhD  
(Massachusetts Institute of Technology)  
Adjunct Professor of Biomedical Engineering (Microbiology, Immunology and Biochemistry, University of Akron)  
Mineralization of vertebrates, effect of mechanical force on mineralization, calcium transport in mineralization, tissue engineering

Mary Laughlin, MD  
(State University of New York)  
Adjunct Professor (Cleveland Cord Blood Center)  
Development of monocytes, hematopoietic stem cells or T cells. Collaborations with faculty and student mentoring.

Scott Lempka, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor  
Neural Engineering, collaborates with BME faculty.

Paul Marasco, PhD  
(Vanderbilt University)  
Adjunct Associate Professor  
Neural Plasticity, Sensory Neurophysiology, Brain Organization, Sensory Integration with Prosthetic devices

Aaron S. Nelson, MD  
(Medical College of Ohio)  
Adjunct Assistant Professor, Medical Director, MIMvista Corporation (Cleveland, OH)  
Multimodality and quantitative imaging for neurologic and cardiac disorders, oncology, and radiation oncology

Marc Penn, MD, MD, PhD, FACC  
(Case Western Reserve University)  
Adjunct Professor (Director of Research, Summa Cardiovascular Institute, Summa Health System)  
Strategies for cardiovascular cell therapy to treat cardiac dysfunction

Suguna Rachakonda, PhD, MBA  
(University of Hyderabad)  
Adjunct Assistant Professor  
consultation on technology commercialization

Enrique Saldivar, PhD, MD  
(University of California)  
Adjunct Associate Professor  
Teaching, student mentoring and collaboration with faculty.

Antonie Van den Bogert, PhD  
(University of Utrecht)  
Adjunct Associate Professor (Orchard Kinetics, LLC)  
Biomechanics, motion capture, computational modeling

Gabriela Voskerician, PhD  
(Case Western Reserve University)  
Adjunct Associate Professor (Krikorjan, Inc.)  
Remote health management

Fredy R. Zypman, PhD  
(Case Western Reserve University)  
Adjunct Professor  
Theoretical and computational applied physics, reconstruction of forces at the nanoscale from experimental Atomic Force Microscopy measurements, and applications to electric and mechanical phenomena in soft matter including interactions in electrolytes. Friction at the nanoscale. Random systems
Courses

**EBME 105. Introduction to Biomedical Engineering. 3 Units.**
This course introduces students to a wide variety of biomedical engineering fields including: biomaterials, biomechanics, biomedical devices & instrumentation, and biomedical computing & analysis. Emphasis is given to recognizing the difference between medical technology as a subject area vs. career tracks within which this subject area is: imagined, designed, fabricated and used. Students learn to distinguish the difference between how a scientist, an engineer, and a clinician are trained and interact with medical technology. Foundational topics like: engineering design, structure-function relationship, biomimicry, and biocompatibility are presented at an introductory level. Students well served by this course include: freshmen trying to decide if they want to major in biomedical engineering, freshman who know they want to major in biomedical engineering but are not certain which track they wish to pursue, and upper classmen in non-biomedical engineering majors who are looking for deeper insight into what this fast growing field is about.

**EBME 201. Physiology-Biophysics I. 3 Units.**
Fundamental concepts of physiology from the cells to organ systems. Cell structure and function: DNA-RNA related enzyme/protein synthesis, membrane permeation (receptors/channels/gates), cellular biochemistry and energetic metabolic functions. Essential systems-level concepts include endocrinology, immunology, cellular/capillary/interphase transport, regulation of fluid volume, solutes, and pH. Liver, renal and respiratory physiology. Basic concepts in thermodynamics, transport and kinetics provide a framework for quantitative analysis and modeling of systems physiology. Prereq: Must have declared major or minor in Biomedical Engineering.

**EBME 202. Physiology-Biophysics II. 3 Units.**
This course is an extension of EBME 201 that will include structure and function of (1) the nervous system, including vision, somatic and proprioceptive sensation, and control of movement, (2) skeletal and smooth muscle, (3) cardiac muscle and the cardiovascular system, and (4) the metabolic system. The material will be taught from a quantitative and functional perspective, with some examples of human pathophysiology. Prereq: EBME 201.

**EBME 300. Dynamics of Biological Systems: A Quantitative Introduction to Biology. 3 Units.**
This course will introduce students to dynamic biological phenomena, from the molecular to the population level, and models of these dynamical phenomena. It will describe a biological system, discuss how to model its dynamics, and experimentally evaluate the resulting models. Topics will include molecular dynamics of biological molecules, kinetics of cell metabolism and the cell cycle, biophysics of excitability, scaling laws for biological systems, biomechanics, and population dynamics. Mathematical tools for the analysis of dynamic biological processes will also be presented. Students will manipulate and analyze simulations of biological processes, and learn to formulate and analyze their own models. This course satisfies a laboratory requirement for the biology major. Offered as BIOL 300 and EBME 300.

**EBME 303. Structure of Biological Materials. 3 Units.**
Structure of proteins, nucleic acids, connective tissue and bone, from molecular to microscopic levels. An introduction to bioengineering biological materials and biomimetic materials, and an understanding of how different instruments may be used for imaging, identification and characterization of biological materials. Offered as: EBME 303 and EMAC 303. Recommended preparation: EBME 201, EBME 202, and EMAC 270.

**EBME 305. Materials for Prosthetics and Orthotics. 3 Units.**
A synthesis of skeletal tissue structure and biology, materials engineering, and strength of materials concepts. This course is centered on deepening the concept of biocompatibility and using it to pose and solve biomaterials problems. We cover: fundamental concepts of materials used for load bearing medical applications, wear, corrosion, and failure of implants. Structure and properties of hard tissues and joints are presented using a size hierarchy motif. Tools and analysis paradigms useful in the characterization of biomaterials are covered in the context of orthopedic and dental applications. Prereq: EBME 306 and EBME 370 or Requisites Not Met permission.

**EBME 306. Introduction to Biomedical Materials. 3 Units.**
Biomaterials design and application in different tissue and organ systems. The relationship between the physical and chemical structure of biomaterials, functional properties, and biological response. Recommended preparation: EBME 201 and EBME 202.

**EBME 307. Biomechanical Prosthetic Systems. 3 Units.**
Introduction to the basic biomechanics of human movement and applications to the design and evaluation of artificial devices intended to restore or improve movement lost due to injury or disease. Measurement techniques in movement biomechanics, including motion analysis, electromyography, and gait analysis. Design and use of upper and lower limb prostheses. Principles of neuroprostheses with applications to paralyzed upper and lower extremities. Recommended preparation: Consent of instructor and senior standing. Prereq: EBME 308.

**EBME 308. Biomedical Signals and Systems. 3 Units.**

**EBME 309. Modeling of Biomedical Systems. 3 Units.**
Mathematical modeling and computational methods applied to biomedical systems. Spatially lumped and distributed models of electrical, mechanical, and chemical processes applied to cells, tissues, organ, and whole-body systems. Prereq: EBME 202 and EBME 308. Coreq: EBME 359.

**EBME 310. Principles of Biomedical Instrumentation. 3 Units.**
Physical, chemical, and biological, and system principles for biomedical measurements. Modular blocks and system integration. Sensors for displacement, force, pressure, flow, temperature, biopotentials, chemical composition of body fluids and biomaterial characterization. Patient safety related to instrumentation will also be covered. Prereq: EBME 308. Coreq: EBME 360.

**EBME 316. Biomaterials for Drug Delivery. 3 Units.**
The teaching objective is to provide students with a basic understanding of the principles of design and engineering of well-defined molecular structures and architectures intended for applications in controlled release and organ-targeted drug delivery. The course will discuss the therapeutic basic of drug delivery based on drug pharmacodynamics and clinical pharmacokinetics. Biomaterials with specialized structural and interfacial properties will be introduced to achieve drug targeting and controlled release. Offered as EBME 316 and EBME 416. Prereq: EBME 306.
EBME 318. Biomedical Engineering Laboratory. 1 Unit.
Experiments for measurement, assisting, replacement, or control of
various biomedical systems. Students choose a few lab experiences from
a large number of offerings relevant to all BME sequences. Experiments
are conducted primarily in faculty labs with 3-8 students participating.
Recommended preparation: ENGR 210. Prereq: BME Major, EBME 201,
EBME 202 and Prereq or Coreq: EBME 308.

EBME 320. Medical Imaging Fundamentals. 3 Units.
General principles, instrumentation, and biomedical applications of
medical imaging. Topics include: x-ray, ultrasound, MRI, nuclear imaging,
image reconstruction, and image quality. Recommended preparation:
EBME 308, ENGR 210, and EBME 202 or equivalent.

EBME 325. Introduction to Tissue Engineering. 3 Units.
The goal of this course is to present students with a firm understanding
of the primary components, design principles, and engineering concepts
central to the field of tissue engineering. First, the biological principles
of tissue formation during morphogenesis and wound repair will be
examined. The cellular processes underlying these events will be
presented with an emphasis on microenvironment regulation of cell
behavior. Biomimetic approaches to controlling cell function and
tissue formation via the development of biomaterial systems will then
be investigated. Case studies of regeneration strategies for specific
tissues will be presented in order to examine the different tissue-specific
engineering strategies that may be employed. Special current topics
in tissue engineering will also be covered. Recommended preparation:
EBME 306, BIOL 362, and CHEM 223.

EBME 327. Bioelectric Engineering. 3 Units.
Quantitative bioelectricity: action potentials and cable equations. Origins
of biopotentials, biopotential recording, electrical stimulation of excitable
tissue, electrodes/electrochemistry and cardiac electrophysiology.
Overview of major biomedical devices. Prereq: EBME 201 and ENGR 210.

EBME 328. Biomedical Engineering R&D Training. 1 Unit.
This course will provide research and development in the laboratory of a
mentoring faculty member. Varied R&D experiences will include activities
in biomedical instrumentation, tissue engineering, imaging, drug delivery,
and neural engineering. Each Student must identify a faculty mentor, and
together they will create description of the training experience prior to the
first class. Prereq: EBME 201 and EBME 202.

EBME 350. Quantitative Molecular, Cellular and Tissue Bioengineering. 3
Units.
Physical and chemical principles associated with kinetics and mass
transport. Molecular-cellular components incorporated in quantitative
analysis of cellular, tissue, and organ systems. Mathematical and
computational modeling developed for diagnostic and therapeutic
applications. Offered as EBME 350 and ECHE 355. Prereq: Senior Status.

EBME 356. Introduction to Biomaterials Engineering - Laboratory. 1 Unit.
This is a core BME Laboratory course directed at providing Biomedical
Engineering undergraduate students 'hands on' experience in a
component of biomaterials engineering, specifically, biocompatibility. To
that end, the course will focus on blood compatibility (hemocompatibility)
of biomaterials, by teaching students how to analyze the interaction
of blood components (proteins, platelets, RBCs) on biomedical
relevant coated versus uncoated polymer surfaces. The students
will learn important characterization techniques like contact angle
measurement, UV-Vis spectroscopy and optical microscopy in the context
of characterizing blood interactions with materials. Prereq: EBME 201
and EBME 202. Prereq or Coreq: EBME 306.

EBME 358. Biomedical Signals and Systems Laboratory. 1 Unit.
Computational laboratory experiences with biomedical applications.
Numerical methods with MATLAB applications in biomedical engineering.
Coreq: EBME 308.

EBME 359. Biomedical Computer Simulation Laboratory. 1 Unit.
Computer simulation of mathematical models of biomedical systems.

EBME 360. Biomedical Instrumentation Laboratory. 1 Unit.
A laboratory which focuses on the basic components of biomedical
instrumentation and provides hands-on experience for students in
EBME 310, Biomedical Instrumentation. The purpose of the course is
to develop design skills and laboratory skills in analysis and circuit
development. Coreq: EBME 310.

EBME 361. Biomedical Image Processing and Analysis. 3 Units.
Principles of image processing and analysis with applications to clinical
and biomedical research. Topics include image filtering, registration,
morphological processing, segmentation, classification, and 3D image
visualization. There will be interesting, realistic computer projects in
Matlab. Offered as EBME 361 and EBME 461. Prereq: EBME 308.

EBME 370. Principles of Biomedical Engineering Design. 2 Units.
Students learn and implement the design process to produce working
prototypes of medical devices with potential commercial value to
meet significant clinical needs. Critical examination of contemporary
medical problems is used to develop a specific problem statement. The
class is divided into teams of 3 to 4 students. Each team integrates
their knowledge and skills to design a device to meet their clinical
need. Project planning and management, including resource allocation,
milestones, and documentation, are required to ensure successful
completion of projects within the allotted time and budget. Formal
design reviews by a panel of advisors and outside medical device
experts are required every four weeks. Every student is required to give
oral presentations at each formal review and is responsible for formal
documentation of the design process, resulting in an executive summary
and complete design history file of the project. The course culminates
with a public presentation of the team's device to a panel of experts. This
course is expected to provide the student with a real-world, capstone
design experience. Recommended preparation: EBME 310 Prereq: Senior
standing or requisites not met permission.

EBME 380. Biomedical Engineering Design Experience. 3 Units.
This course is the culmination of the BME educational experience in
which the student will apply acquired skills and knowledge to create a
working device or product to meet a medical need. Students will learn
how to apply engineering skills to solve problems and physically realize
a project design. The course structure includes regular meetings with a
faculty project advisor, regular reports of accomplished activity, hands on
fabrication of devices, and several lectures from leading engineers from
industry and academia that have first hand experience in applying the
principles of design to Biomedical Engineering. Students will also provide
periodic oral progress reports and a final oral presentation with a written
design report. Counts as SAGES Senior Capstone. Prereq: EBME 370 and
Senior standing or requisites not met permission.

EBME 396. Special Topics in Undergraduate Biomedical Engineering I. 1 -
18 Units.
(Credit as arranged.)
EBME 398. Biomedical Engineering Research Experience I. 3 Units.
Biomedical engineering seniors can participate in a research project under the supervision of any qualified CWRU faculty member with the approval of a Primary BME faculty member. Guided by the supervising faculty member, each student develops and performs a research or design project. Students are encouraged to work with others in the faculty laboratory, but they must make a major contribution to the project. A research project is expected to include a significant engineering component, such as design and/or analysis. A design project must include a significant research component, such as applying the developed design to solve an actual biomedical problem. This course requires a final technical report and a short oral presentation by the student. In advance of registration, all students must submit a course proposal (see FORMS on the BME web site). This proposal must be approved by their research mentor and submitted via email for approval by the course instructor. This course can qualify as a technical elective if the project includes material pertinent to the student’s BME track and is approved in advance by the BME faculty member responsible for the BME track. To be approved as a technical elective, the project proposal should identify the new technical material the student will master, and a plan for assessing mastery.

EBME 399. Biomedical Engineering Research Experience II. 3 Units.
Continuation of EBME 398. Consent of Instructor required. Prereq: EBME 398.

EBME 400T. Graduate Teaching I. 0 Unit.
This will provide the Ph.D. candidate with experience in teaching undergraduate or graduate students. The experience is expected to consist of direct student contact, but will be based upon the specific departmental needs and teaching obligations. This teaching experience will be conducted under the supervision of the faculty member who is responsible for the course, but the academic advisor will assess the educational plan to ensure that it provides an educational opportunity for the student. Recommended preparation: UNIV 400, BME Ph.D. student.

EBME 401D. Biomedical Instrumentation and Signal Processing. 3 Units.
Graduate students with various undergraduate backgrounds will learn the fundamental principles of biomedical measurements that integrate instrumentation and signal processing with problem-based hands-on experience. Recommended preparation: Undergraduate circuit and signal processing class.

EBME 402. Organ/Tissue Physiology and Systems Modeling. 4 Units.
Graduate students with various undergraduate backgrounds will learn the fundamental principles of organ and tissue physiology as well as systems modeling. Prereq: Graduate Status.

EBME 406. Polymers in Medicine. 3 Units.
This course covers the important fundamentals and applications of polymers in medicine, and consists of three major components: (i) the blood and soft-tissue reactions to polymer implants; (ii) the structure, characterization and modification of biomedical polymers; and (iii) the application of polymers in a broad range of cardiovascular and extravascular devices. The chemical and physical characteristics of biomedical polymers and the properties required to meet the needs of the intended biological function will be presented. Clinical evaluation, including recent advances and current problems associated with different polymer implants. Recommended preparation: EBME 306 or equivalent. Offered as EBME 406 and EMAC 471. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

EBME 407. Neural Interfacing. 3 Units.
Neural interfacing refers to the principles, methods, and devices that bridge the boundary between engineered devices and the nervous system. It includes the methods and mechanisms to get information efficiently and effectively into and out of the nervous system to analyze and control its function. This course examines advanced engineering, neurobiology, neurophysiology, and the interaction between all of them to develop methods of connecting to the nervous system. The course builds on a sound background in Bioelectric Phenomenon to explore fundamental principles of recording and simulation, electrochemistry of electrodes in biological tissue, tissue damage generated by electrical stimulation, materials and material properties, and molecular functionalization of devices for interfacing with the nervous system. Several examples of the state-of-art neural interfaces will be analyzed and discussed. Recommended preparation: EBME 401. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

EBME 409. Systems and Signals in Biomedical Engineering. 3 Units.

EBME 410. Medical Imaging Fundamentals. 3 Units.
Physical principles of medical imaging. Imaging devices for x-ray, ultrasound, magnetic resonance, etc. Image quality descriptions. Patient risk. Recommended preparation: EBME 308 and EBME 310 or equivalent. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

EBME 416. Biomaterials for Drug Delivery. 3 Units.
The teaching objective is to provide students with a basic understanding of the principles of design and engineering of well-defined molecular structures and architectures intended for applications in controlled release and organ-targeted drug delivery. The course will discuss the therapeutic basic of drug delivery based on drug pharmacodynamics and clinical pharmacokinetics. Biomaterials with specialized structural and interfacial properties will be introduced to achieve drug targeting and controlled release. Offered as EBME 316 and EBME 416. Prereq: EBME 306 and PHRM 309 or graduate standing.
EBME 419. Applied Probability and Stochastic Processes for Biology. 3 Units.
Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419.

EBME 421. Bioelectric Phenomena. 3 Units.
The goal of this course is to provide working knowledge of the theoretical methods that are used in the fields of electrophysiology and bioelectricity for both neural and cardiac systems. These methods will be applied to describe, from a theoretical and quantitative perspective, the electrical behavior of excitable cells, the methods for recording their activity and the effect of applied electrical and magnetic fields on excitable issues. A team modeling project will be required. Recommended preparation: differential equations, circuits. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

EBME 422. Muscles, Biomechanics, and Control of Movement. 4 Units.
Quantitative and qualitative descriptions of the action of muscles in relation to human movement. Introduction to rigid body dynamics and dynamics of multi-link systems using Newtonian and Lagrangian approaches. Muscle models with application to control of multi-joint movement. Forward and inverse dynamics of multi-joint, muscle driven systems. Dissection, observation and recitation in the anatomy laboratory with supplemental lectures concentrating on kinesiology and muscle function. Recommended preparation: EMAE 181 or equivalent. Offered as EBME 422 and EMAE 402. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

EBME 425. Tissue Engineering and Regenerative Medicine. 3 Units.
This course will provide advanced coverage of tissue engineering with a focus on stem cell-based research and therapies. Course topics of note include stem cell biology and its role in development, modeling of stem cell function, controlling stem cell behavior by engineering materials and their microenvironment, stem cells’ trophic character, and state-of-the-art stem cell implementation in tissue engineering and other therapeutic strategies. Prereq: PhD student in an engineering program or EBME 325 or requisites not met permission.

EBME 426. Nanomedicine. 3 Units.

EBME 427. Movement Biomechanics and Rehabilitation. 3 Units.
Introduction to the basic biomechanics of human movement and applications to the design and evaluation of artificial devices intended to restore or improve movement lost due to injury or disease. Measurement techniques in movement biomechanics, including motion analysis, electromyography, and gait analysis. Design and use of upper and lower limb prostheses. Principles of neuroprostheses with applications to paralyzed upper and lower extremities. Term paper required. Recommended preparation: Consent of instructor and graduate standing. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

EBME 431. Physics of Imaging. 3 Units.
Description of physical principles underlying the spin behavior in MR and Fourier imaging in multi-dimensions. Introduction of conventional, fast, and chemical-shift imaging techniques. Spin echo, gradient echo, and variable flip-angle methods. Projection reconstruction and sampling theorems. Bloch equations, T1 and T2 relaxation times, rf penetration, diffusion and perfusion. Flow imaging, MR angiography, and functional brain imaging. Sequence and coil design. Prerequisite may be waived with consent of instructor. Recommended preparation: PHYS 122 or PHYS 124 or EBME 410. Offered as EBME 431 and PHYS 431.

EBME 432. Quantitative Analysis of Physiological Systems. 3 Units.

EBME 433. Advanced Topics for Physiological Systems Analysis. 4 Units.

EBME 440. Translational Research for Biomedical Engineers. 3 Units.
Translational Research (TR) in the Biomedical Engineering context means translating laboratory discoveries or developments into improved health care. Topics and activities include: Interdisciplinary teamwork and communication; Research ethics and human subjects protection; Regulation and oversight of human subjects and animal research; Clinical validation study design and biostatistics; Intellectual property, technology transfer and commercialization; Physician shadowing; Attending Grand Rounds and Morbidity-Mortality conferences; Preparing IRB and IACUC protocols; Final integrative project. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.
EBME 447A. Rehabilitation for Scientists and Engineers. 0 Unit.
Medical, psychological, and social issues influencing the rehabilitation of people with spinal cord injury, stroke, traumatic brain injury, and limb amputation. Epidemiology, anatomy, pathophysiology and natural history of these disorders, and the consequences of these conditions with respect to impairment, disability, handicap, and quality of life. Students will directly observe the care of patients in each of these diagnostic groups throughout the full continuum of care starting from the acute medical and surgical interventions to acute and subacute rehabilitation, outpatient medical and rehabilitation management and finally to community re-entry.

EBME 447B. Rehabilitation for Scientists and Engineers. 3 Units.
Medical, psychological, and social issues influencing the rehabilitation of people with spinal cord injury, stroke, traumatic brain injury, and limb amputation. Epidemiology, anatomy, pathophysiology and natural history of these disorders, and the consequences of these conditions with respect to impairment, disability, handicap, and quality of life. Students will directly observe the care of patients in each of these diagnostic groups throughout the full continuum of care starting from the acute medical and surgical interventions to acute and subacute rehabilitation, outpatient medical and rehabilitation management and finally to community re-entry. Coreq: EBME 447A.

EBME 451. Molecular and Cellular Physiology. 3 Units.
This course covers cellular and molecular basics for graduate students with little or no prior biology background. The emphasis of EBME 451 is on the molecular and cellular mechanisms underlying physiological processes. Structure-function relationship will be addressed throughout the course. The primary goal of the course is to develop understanding of the principles of the physiological processes at molecular and cellular level and to promote independent thinking and ability to solve unfamiliar problems. This course is no longer a core course of the Biomedical Engineering graduate curriculum but serves as a fundamentals course to prepare students for the graduate cellular and molecular physiology core. Prereq: Graduate standing.

EBME 460. Advanced Topics in NMR Imaging. 3 Units.
Frontier issues in understanding the practical aspects of NMR imaging. Theoretical descriptions are accompanied by specific examples of pulse sequences, and basic engineering considerations in MRI system design. Emphasis is placed on implications and trade-offs in MRI pulse sequence design from real-world versus theoretical perspectives. Recommended preparation: EBME 431 or PHYS 431. Offered as EBME 460 and PHYS 460. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

EBME 461. Biomedical Image Processing and Analysis. 3 Units.
Principles of image processing and analysis with applications to clinical and biomedical research. Topics include image filtering, registration, morphological processing, segmentation, classification, and 3D image visualization. There will be interesting, realistic computer projects in Matlab. Offered as EBME 361 and EBME 461. Prereq: EBME 401.

EBME 467. Commercialization and Intellectual Property Management. 3 Units.
This interdisciplinary course covers a variety of topics, including principles of intellectual property and intellectual property management, business strategies and modeling relevant to the creation of start-up companies and exploitation of IP rights as they relate to biomedical-related inventions. The goal of this course is to address issues relating to the commercialization of biomedical-related inventions by exposing law students, MBA students, and Ph.D. candidates (in genetics and proteomics) to the challenges and opportunities encountered when attempting to develop biomedical intellectual property from the point of early discovery to the clinic and market. Specifically, this course seeks to provide students with the ability to value a given technological advance or invention holistically, focusing on issues that extend beyond scientific efficacy and include patient and practitioner value propositions, legal and intellectual property protection, business modeling, potential market impacts, market competition, and ethical, social, and healthcare practitioner acceptance. During this course, law students, MBA students, and Ph.D. candidates in genomics and proteomics will work in teams of five (two law students, two MBA students and one Ph.D. candidate), focusing on issues of commercialization and IP management of biomedical-related inventions. The instructors will be drawn from the law school, business school, and technology transfer office. Please visit the following website for more information: fusioninnovate.com. Offered as LAWS 5341, MGMT 467, GENE 367, GENE 467, EBME 467 and EECS 467.

EBME 471. Principles of Medical Device Design and Innovation. 3 Units.
Translational research leading to medical device innovation is highly interdisciplinary, requiring a systematic, structured approach to bringing new medical technologies to market. This course provides the fundamental principles of the Biodesign innovation process, providing the student the essential tools to (A) identify unmet clinical needs, (B) create innovative medical device concepts that respond to a primary unmet need, and (C) understand the process for translating these concepts into the market. In short, the student learns the fundamental principles for the process of identify, invent, implement in the field of Biodesign.

EBME 472. BioDesign. 3 Units.
Medical device innovations that would have been considered science fiction a decade ago are already producing new standards of patient care. Innovation leading to lower cost of care, minimally invasive procedures and shorter recovery times is equally important to healthcare business leaders, educators, clinicians, and policy-makers. Innovation is a driver of regional economic development and wealth creation in organizational units ranging in size from the start-up to the Fortune 500 companies. In a broader context, the pace of translational research leading to product and service innovation is highly interdisciplinary, thus, new products and services result from team efforts, marked by a systematic, structured approach to bringing new medical technologies to market and impacting patient care. In this course we examine medical technology innovations in the context of (A) addressing unmet clinical needs, (B) the process of inventing new medical devices and instruments, and (C) subsequent implementation of these advances in patient care. In short, the student learns the process of "identify, invent, implement" in the field of BioDesign. Offered as EBME 472, IIME 472 and SYBB 472.
EBME 473. Fundamentals of Clinical Information Systems. 3 Units.
Technology has played a significant role in the evolution of medical science and treatment. While we often think about progress in terms of the practical application of, say, imaging to the diagnosis and monitoring of disease, technology is increasingly expected to improve the organization and delivery of healthcare services, too. Information technology plays a key role in the transformation of administrative support systems (finance and administration), clinical information systems (information to support patient care), and decision support systems (managerial decision-making). This introductory graduate course provides the student with the opportunity to gain insight and situational experience with clinical information systems (CIS). Often considered synonymous with electronic medical records, the "art" of CIS more fundamentally examines the effective use of data and information technology to assist in the migration away from paper-based systems and improve organizational performance. In this course we examine clinical information systems in the context of (A) operational and strategic information needs, (B) information technology and analytic tools for workflow design, and (C) subsequent implementation of clinical information systems in patient care. Legal and ethical issues are explored. The student learns the process of "plan, design, implement" through hands-on applications to select CIS problems, while at the same time gaining insights and understanding of the impacts placed on patients and health care providers. Offered as EBME 473, IIME 473 and SYBB 421.

EBME 474. Biotransport Processes. 3 Units.
Biomedical mass transport and chemical reaction processes. Basic mechanisms and mathematical models based on thermodynamics, mass and momentum conservation. Analytical and numerical methods to simulate in vivo processes as well as to develop diagnostic and therapeutic methods. Applications include transport across membranes, transport in blood, tumor processes, bioreactors, cell differentiation, chemotaxis, drug delivery systems, tissue engineering processes. Recommended preparation: EBME 350 or equivalent. Offered as EBME 474 and ECHE 474.

EBME 478. Computational Neuroscience. 3 Units.
Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECs 478, MATH 478 and NEUR 478.

EBME 480A. Introduction to Wireless Health. 3 Units.
Study of convergence of wireless communications, microsystems, information technology, persuasive psychology, and health care. Discussion of health care delivery system, medical decision-making, persuasive psychology, and wireless health value chain and business models. Understanding of health information technology, processing of monitoring data, wireless communication, biomedical sensing techniques, and health monitoring technical approaches and solutions. Offered as EECs 480A and EBME 480A.

EBME 480B. The Human Body. 3 Units.
Study of structural organization of the body. Introduction to anatomy, physiology, and pathology, covering the various systems of the body. Comparison of elegant and efficient operation of the body and the related consequences of when things go wrong, presented in the context of each system of the body. Introduction to medical diagnosis and terminology in the course of covering the foregoing. Offered as EECs 480B and EBME 480B.

EBME 480C. Biomedical Sensing Instrumentation. 3 Units.
Study of principles, applications, and design of biomedical instruments with special emphasis on transducers. Understanding of basic sensors, amplifiers, and signal processing. Discussion of the origin of biopotential, and biopotential electrodes and amplifiers (including biotelemetry). Understanding of chemical sensors and clinical laboratory instrumentation, including microfluidics. Offered as EECs 480C and EBME 480C. Prereq: EECs/EBME 480A, EECs/EBME 480B

EBME 480D. The Health Care Delivery Ecosystem. 3 Units.
Health care delivery across the continuum of care in the United States, including health policy and reform, financing of care, comparative health systems, population health, public health, access to care, care models, cost and value, comparative effectiveness, governance, management, accountability, workforce, and the future. Discussions of opportunities and challenges for wireless health, integrated into the foregoing topics. Perspective on health care delivery in other countries. Offered as EECs 480D and EBME 480D.

EBME 480E. Wireless Communications and Networking. 3 Units.
Essentials of wireless communications and networking, including teletraffic engineering, radio propagation, digital and cellular communications, wireless wide-area network architecture, speech and channel coding, modulation schemes, antennas, security, networking and transport layers, and 4G systems. Hands-on learning of the anatomy of a cell phone, and a paired wireless health device and its gateway. Offered as EECs 480E and EBME 480E.

EBME 480F. Physicians, Hospitals and Clinics. 3 Units.
Rotation through one or more health care provider facilities for a first-hand understanding of care delivery practice, coordination, and management issues. First-hand exposure to clinical personnel, patients, medical devices and instruments, and organizational workflow. Familiarity with provider protocols, physician referral practices, electronic records, clinical decision support systems, acute and chronic care, and inpatient and ambulatory care. Offered as EECs 480F and EBME 480F.

EBME 480M. Introduction to Medical Informatics. 3 Units.
Current state and emerging trends in Medical Informatics (MI) and associated health information systems. Principles, data, data management, system interoperability, patient privacy, information security, electronic records, telehealth, regulatory issues, clinical decision support, mobile documentation, devices and wireless communications in healthcare. Impact of wireless technology on emerging health information systems and processes. Offered as EECs 480M and EBME 480M.

EBME 480O. Introduction to Health Information Technology Implementation. 3 Units.
Current state and emerging trends in the implementation and adoption of health information technology (HIT). Macroergonomics; Technology transfer and adoption; Systems adoption life cycle; Impact of regulation; Decision and work transformation; HIT specification and acquisition; Contracting issues; Implementation, use, and evaluation; Impact of wireless technology on emerging processes. Offered as EECs 4800 and EBME 4800. Prereq: EBME 480M.
**EBME 480P. Advanced Biomedical Instrumentation. 3 Units.**
Analysis and design of biosensors in the context of biomedical measurements. Base sensors using electrochemical, optical, piezoelectric, and other principles. Binding equilibria, enzyme kinetics, and mass transport modalities. Adding the "bio" element to base sensors and mathematical aspects of data evaluation. Applications to clinical problems and biomedical research. Offered as EECS 480P and EBME 480P.

**EBME 480Q. Regulatory Policy and Regulations. 3 Units.**
Introduction of wireless health technologies: spectrum, licensed versus unlicensed; personal area networks; body area networks; ultra-wideband low energy level short-range radios; wireless local area networks; wide area networks. The Federal system: separation of powers; the executive branch and its departments; the House of Representatives and its committees; the Senate and its committees; the FCC; policy versus regulatory versus legislative. What is a medical device: FDA; classification system; radiation-emitting products; software; RF in medical devices; converged medical devices; international aspects. Regulation of health information technology and wireless health: American Recovery and Reinvestment Act; Patient Protection and Affordable Care Act; FCC/ FDA MoU; CMS and Reimbursement; privacy and security. Offered as EECS 480Q and EBME 480Q.

**EBME 480R. User Experience Engineering. 3 Units.**
Social, cognitive, behavioral, and contextual elements in the design of healthcare technology and systems. User-centered design paradigm from a broad perspective, exploring dimensions of product user experience and learning to assess and modify the design of healthcare technology. Practical utilization of user centered design method and assessment techniques for approaching a design problem. Offered as EECS 480R and EBME 480R.

**EBME 480S. Wireless Health Product Development. 3 Units.**
Integrating application requirements, market data, concept formulation, design innovation, and manufacturing resources for creating differentiated wireless health products that delight the user. Learning user-centric product development best practices, safety, security and privacy considerations, and risk management planning. Understanding the regulatory process. Identifying and managing product development tradeoffs. Offered as EECS 480S and EBME 480S. Prereq: EBME 480R.

**EBME 500T. Graduate Teaching III. 0 Unit.**
This course will provide the Ph.D. candidate with experience in teaching undergraduate or graduate students. The experience is expected to consist of direct student contact, but will be based upon the specific departmental needs and teaching obligations. This teaching experience will be conducted under the supervision of the faculty member who is responsible for the course, but the academic advisor will assess the educational plan to ensure that it provides an educational opportunity for the students. Recommended preparation: EBME 500T, BME Ph.D. student.

**EBME 504. Advanced Electromagnetic Fields. 3 Units.**
Introduction to electromagnetic theory, field equations, and boundary conditions. Applications to medical devices, microwave and millimeter wave engineering, and antenna design. Microwave communication systems. Introduced numerical analysis and computational methods. Prereq: EECS 480Q and EBME 480Q.

**EBME 507. Motor System Neuroprostheses. 3 Units.**
Fundamentals of neural stimulation and sensing, neurophysiology and pathophysiology of common neurological disorders, general implantation and clinical deployment issues. Specialist discussions in many application areas such as motor prostheses for spinal cord injury and stroke, cochlear implants, bladder control, stimulation for pain management, deep brain stimulation, and brain computer interfacing. Prereq: Graduate standing.

**EBME 513. Biomedical Optical Diagnostics. 3 Units.**
Engineering design principles of optical instrumentation for medical diagnostics. Elastic and inelastic light scattering theory and biomedical applications. Confocal and multiphoton microscopy. Light propagation and optical tomographic imaging in biological tissues. Design of minimally invasive spectroscopic diagnostics. Recommended preparation: EBME 403 or PHYS 326 or consent. Prereq: Graduate standing.

**EBME 519. Parameter Estimation for Biomedical Systems. 3 Units.**

**EBME 570. Graduate Professional Development for Biomedical Engineers. 1 Unit.**
Students will be trained in topics including public speaking, grant writing, notebook management, professionalism, etc. Prereq: Graduate standing.

**EBME 600T. Graduate Teaching II. 0 Unit.**
This course will provide the Ph.D. candidate with experience in teaching undergraduate or graduate students. The experience is expected to consist of direct student contact, but will be based upon the specific departmental needs and teaching obligations. This teaching experience will be conducted under the supervision of the faculty member who is responsible for the course, but the academic advisor will assess the educational plan to ensure that it provides an educational opportunity for the students. Recommended preparation: EBME 500T, BME Ph.D. student.

**EBME 601. Research Projects. 1 - 18 Units.**
**EBME 602. Special Topics. 1 - 18 Units.**
**EBME 611. BME Departmental Seminar I. .5 Unit.**
Lectures by invited speakers on subjects of current interest in biomedical engineering. Students will be evaluated on reading and preparation of questions for select speakers, as well as weekly participation. Between this course and EBME 612 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters.

**EBME 612. BME Departmental Seminar II. .5 Unit.**
Lectures by invited speakers on subjects of current interest in biomedical engineering. Students will be evaluated on reading and preparation of questions for select speakers, as well as weekly participation. Between this course and EBME 611 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters.

**EBME 613. Topic Seminars for NeuroEngineering Students. .5 Unit.**
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students in NeuroEngineering. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 614 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.
EBME 614. Topic Seminars for NeuroEngineering Students. .5 Unit.
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students in NeuroEngineering. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 613 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.

EBME 615. Topic Seminars for Imaging Students. .5 Unit.
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students in Imaging. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 616 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.

EBME 616. Topic Seminars for Imaging Students. .5 Unit.
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students in Imaging. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 615 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.

EBME 617. Topic Seminars for Biomaterials Students. .5 Unit.
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students in Biomaterials. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 618 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.

EBME 618. Topic Seminars for Biomaterials Students. .5 Unit.
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students in Biomaterials. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 617 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.

EBME 619. Topic Seminars for Miscellaneous Biomedical Engineering Students. .5 Unit.
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students in outside of NeuroEngineering, Imaging, and Biomaterials. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 620 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.

EBME 620. Topic Seminars for Miscellaneous Biomedical Engineering Students. .5 Unit.
Lectures by students in the seminar series on subjects of current interest to biomedical engineering students on topics outside of NeuroEngineering, Imaging, and Biomaterials. Students will be evaluated on presentation preparation and performance, as well as weekly participation. Between this course and EBME 619 students must earn a minimum of 1 credit (two semesters) and can take up to 4 credits over eight different semesters. Prereq: Graduate standing.

EBME 651. Thesis M.S.. 1 - 18 Units.
EBME 701. Dissertation Ph.D.. 1 - 9 Units.
Ph.D. candidates only. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Chemical and Biomolecular Engineering
116 A.W. Smith Building (7217)
http://engineering.case.edu/eche/
Phone: 216.368.4182
Daniel Lacks, Professor and Chair
daniel.lacks@case.edu

The Department of Chemical and Biomolecular Engineering offers Bachelor of Science in Engineering, Master of Science, and Doctor of Philosophy degree programs. The department has twelve full-time faculty members, all of whom lead active research programs in advanced and emerging areas of chemical and biomolecular engineering.

Mission
The Department of Chemical and Biomolecular Engineering inspires learning and the pursuit of scholarly activities in chemical and biological engineering and related science and engineering disciplines. The Department offers educational programs and a research environment that enable our graduates to succeed in an evolving workplace, provides opportunities for students and faculty to advance knowledge at the highest levels of the profession, and addresses technological and personnel needs of industry, governments, and society.

Background
The profession of chemical engineering involves the analysis, design, operation and control of processes that convert matter and energy to more useful forms, encompassing processes at all scales from the molecular to the megascale. Traditionally, chemical engineers are responsible for the production of basic chemicals, plastics, and fibers. However, today’s chemical engineers are also involved in food and fertilizer production, synthesis of electronic materials, waste recycling, and power generation. Chemical engineers also develop new materials (ceramic composites and electronic chips, for example) as well as biochemicals and pharmaceuticals. The breadth of training in engineering and the sciences gives chemical engineers a particularly wide spectrum of career opportunities. Chemical engineers work in the chemical and materials related industries, in government, and are accepted by graduate schools in engineering, chemistry, medicine, and law.

Research
Research in the department is sponsored by a variety of state and federal agencies, by private industry, and by foundations. Current active research topics include:

Energy
- Novel energy storage systems for transportation, grid storage applications, and portable devices
- Energy efficient extraction and processing of materials
- Fuel cells and batteries
- Novel catalysts, electrocatalysts, and plasmas for conversion of gases to fuels
- Simulation, modeling, and fundamental characterization of transport and interfacial processes in electrochemical energy storage and conversion systems

Simulation, modeling, and fundamental characterization of transport and interfacial processes in electrochemical energy storage and conversion systems.
Materials
- Advanced materials for electronic and electrochemical device applications
- Novel synthesis and deposition methods and reactor designs, including electrochemical and plasma reactors
- Novel characterization of materials and in situ reactor diagnostics
- Simulation and theory of materials properties
- Surface properties and interfacial phenomena
- Materials processing and engineering at molecular through macro scales
- Novel separations processes

Biomolecular Engineering
- Biosensors
- Cell and tissue engineering
- Biocatalysis and protein engineering

Undergraduate Programs
The Bachelor of Science degree program in Chemical Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

Program Educational Objectives
The undergraduate program in chemical engineering seeks to produce graduates who will:
1. be able to excel in professional careers across a broad range of industries
2. apply the knowledge and skills acquired through the chemical engineering curriculum to positively contribute to their profession and society
3. assume positions of responsibility and/or leadership in academia, industry, government, and business
4. succeed in post-graduate and professional degree programs

Student Outcomes
In preparation for achieving the above educational objectives, the BS degree program in Chemical Engineering is designed so that students attain:
- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multidisciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues

Bachelor of Science in Engineering
Required Courses: Major in Chemical Engineering
In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

Major Required Courses
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECHE 151</td>
<td>Introduction to Chemical Engineering At Case</td>
<td>1</td>
</tr>
<tr>
<td>ECHE 260</td>
<td>Introduction to Chemical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECHE 360</td>
<td>Transport Phenomena for Chemical Systems</td>
<td>4</td>
</tr>
<tr>
<td>ECHE 361</td>
<td>Separation Processes</td>
<td>3</td>
</tr>
<tr>
<td>ECHE 362</td>
<td>Chemical Engineering Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>ECHE 363</td>
<td>Thermodynamics of Chemical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECHE 364</td>
<td>Chemical Reaction Processes</td>
<td>3</td>
</tr>
<tr>
<td>ECHE 365</td>
<td>Measurements Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>ECHE 367</td>
<td>Process Control</td>
<td>4</td>
</tr>
<tr>
<td>ECHE 398</td>
<td>Process Analysis and Design</td>
<td>3</td>
</tr>
<tr>
<td>ECHE 399</td>
<td>Chemical Engineering Design Project</td>
<td>3</td>
</tr>
</tbody>
</table>

Related Required Courses
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 323</td>
<td>Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>CHEM 290</td>
<td>Chemical Laboratory Methods for Engineers</td>
<td>3</td>
</tr>
</tbody>
</table>

Science Elective: One of the following courses:
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 224</td>
<td>Introductory Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>or any 300 level or higher lecture-based course in Chemistry, Physics, Biology, or Biochemistry</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Materials Elective: One of the following courses:
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAC 270</td>
<td>Introduction to Polymer Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 276</td>
<td>Polymer Properties and Design</td>
<td></td>
</tr>
<tr>
<td>EMSE 276</td>
<td>Materials Properties and Design</td>
<td></td>
</tr>
<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>3</td>
</tr>
<tr>
<td>or any 300 level or higher lecture-based course in Materials Science and Engineering or Macromolecular Science and Engineering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Physical Chemistry Elective: One of the following courses:

* CHEM 336  Physical Chemistry II
  PHYS 221  Introduction to Modern Physics
  PHYS 313  Thermodynamics and Statistical Mechanics
  PHYS 331  Introduction to Quantum Mechanics I
  BIOC 334  Structural Biology
  EMSE 343  Materials for Electronics and Photonics
  EECS 321  Semiconductor Electronic Devices

Total Units 9-11

* A single course can only satisfy only one of the Science, Materials, and Physical Chemistry electives; it cannot double count to satisfy two of these electives.

Breadth Elective Sequences

A distinctive feature of the chemical engineering program is the three-course breadth elective sequence that enables a student to specialize in a technical or professional area that complements the chemical engineering core. Breadth elective sequences that have standing departmental approval are described below. Alternatively, students may design their own breadth elective sequence, which must be approved by the department.

Biochemical Engineering (Advisor: Dr. Baskaran)

BIOL 301  Biotechnology Laboratory: Genes and Genetic Engineering 3
BIOL 343  Microbiology (Spring) 3
ECHE 340  Biochemical Engineering (Spring) 3

Total Units 9

Computing (Advisor: Dr. Lacks)

EECS 281  Logic Design and Computer Organization 4
EECS 346  Engineering Optimization (Spring) 3
One additional EECS course at 200 level or above 3-4

Total Units 10-11

Electrochemical Engineering (Advisor: Dr. Landau)

ECHE 381  Electrochemical Engineering (Spring) 3
ECHE 383  Chemical Engineering Applied to Microfabrication and Devices (Fall) 3
One additional course selected from:
  EMSE 343  Materials for Electronics and Photonics 3
  EECS 309  Electromagnetic Fields I (Fall) 3
  EECS 321  Semiconductor Electronic Devices (Spring) 3
  ECHE 481  Corrosion Fundamentals 3

Total Units 9

Electronic Materials (Advisor: Dr. Liu)

ECHE 383  Chemical Engineering Applied to Microfabrication and Devices (Fall) 3
EECS 309  Electromagnetic Fields I (Fall) 3
One additional course selected from:
  EMSE 343  Materials for Electronics and Photonics 3
  EECS 321  Semiconductor Electronic Devices (Spring) 3

Total Units 9

Energy (Advisor: Dr. Savinell)

ECHE 381  Electrochemical Engineering (Fall) 3
Two additional courses selected from approved energy course in Engineering, Physics, Chemistry, Management, or Law 6-7

Total Units 9-10

Environmental Engineering (Advisor: Dr. Feke)

ECIV 368  Environmental Engineering (Spring) 3
Two additional courses selected from:
  ECIV 351  Engineering Hydraulics and Hydrology 3
  ECIV 361  Water Resources Engineering (Fall) 3
  ECIV 362  Solid and Hazardous Waste Management (Spring) 3
  ESTD 398  Seminar in Environmental Studies (Fall) 3
  EEPS 220  Environmental Geology 3
  EEPS 303  Environmental Law 3
  EEPS 321  Hydrogeology 3
  EECS 342  Introduction to Global Issues (Fall) 3

Total Units 9

Management/Entrepreneurship (Advisor: Dr. Savinell)

ACCT 203  Survey of Accounting 3
Two additional courses selected from:
  BAFI 355  Corporate Finance (Fall) 3
  or BAFI 341  Money and Banking 3
  BLAW 331  Legal Environment of Management 3
  ENTP 301  Entrepreneurial Strategy 3
  or ENTP 311  Entrepreneurship and Wealth Creation 3
  OPRE 301  Operations Research and Supply Chain Management 3
  MGMT 315  International Management Institute 3

Total Units 9

Polymer Science (Advisor: Dr. Akolkar)

EMAC 270  Introduction to Polymer Science and Engineering (Fall) 3
Two additional courses selected from:
  EMAC 276  Polymer Properties and Design (Spring) 3
  EMAC 376  Polymer Engineering (Spring) 3
  EMAC 377  Polymer Processing (Spring) 3

Total Units 9
EMAC 378  Polymer Engineer Design Product (Spring)
EMAC 303  Structure of Biological Materials

Total Units 9

Pre-Medical (Advisor: Dr. Baskaran)
CHEM 113  Principles of Chemistry Laboratory  2
BIOL 214  Genes, Evolution and Ecology  3
BIOL 214L  Genes, Evolution and Ecology Lab  1
BIOL 215  Cells and Proteins  3
BIOL 215L  Cells and Proteins Laboratory  1

Total Units 10

Research (Advisor: Dr. Martin)
ECHE 350  Undergraduate Research Project I (Fall)  3
ECHE 351  Undergraduate Research Project II  3
An elective course approved by sequence advisor  3

Total Units 10

Systems and Control (Advisor: Dr. Lacks)
EECS 346  Engineering Optimization (Spring)  3
EECS 281  Logic Design and Computer Organization (Fall)  4
EECS 304  Control Engineering I with Laboratory (Spring)  3

Total Units 10

BS/MS Advanced Study Sequence (Advisor: Dr. Martin)
Three 400-level 3-credit ECHE courses  9

Total Units 9

Custom-Designed Sequence (Advisor: Dr. Lacks)
Students can design a custom breadth elective sequence, consisting of three courses (9 credits) that fit in one coherent technical or professional theme. The courses must be technical or professional courses (see footnote b) that are 200-level or higher, with at least one of the courses being 300-level or higher. These courses cannot be research or independent study courses. Students interested in this option should submit a petition to their advisor naming and explaining the coherent theme, why this theme complements the chemical engineering core for him/her, and how the three courses fit into this theme. The petition must be approved by the faculty of the Department of Chemical and Biomolecular Engineering.

b  For the purpose of the sequences, “technical and professional courses” are defined as courses that would not satisfy the humanities and social sciences requirement of the Case School of Engineering; also excluded are courses in American Studies (AMST), Asian Studies (ASIA), Childhood studies (CHST), ethics (ETHS), Judaic studies (JDST), music (MUAP), education (EDUC), women’s and gender studies (WGST), Washington study program (WASH), and other courses deemed by the department to be of this genre.

Bachelor of Science in Engineering
Suggested Program of Study: Major in Chemical Engineering
The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

First Year

<table>
<thead>
<tr>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
</tr>
<tr>
<td>Spring</td>
</tr>
</tbody>
</table>

General Physics I - Mechanics (PHYS 121)**c or Physics and Frontiers I - Mechanics (PHYS 123)  4
Principles of Chemistry for Engineers (CHEM 111)**  4
Calculus for Science and Engineering I (MATH 121)**c or Calculus I (MATH 123)  4
FSxx SAGES First Seminar*  4
Introduction to Chemical Engineering at Case (ECHE 151)  1
PHED (2 half semester courses)*  0
General Physics II - Electricity and Magnetism (PHYS 122)**c or Physics and Frontiers II - Electricity and Magnetism (PHYS 124)  4
Chemistry of Materials (ENGR 145)**  4
Calculus for Science and Engineering II (MATH 122)**c or Calculus II (MATH 124)  4
Elementary Computer Programming (ENGR 131)**  3
USxx SAGES University Seminar I*  3
PHED (2 half semester courses)*  0
Year Total:  17  18

Second Year

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
</tr>
<tr>
<td>Spring</td>
</tr>
</tbody>
</table>

Introductory Organic Chemistry I (CHEM 223)c or Organic Chemistry I (CHEM 323)  3
Calculus for Science and Engineering III (MATH 223)**c or Calculus III (MATH 227)  3
Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**  4
Introduction to Chemical Systems (ECHE 260)  3
USxx SAGES University Seminar II  3
Elementary Differential Equations (MATH 224)**c or Differential Equations (MATH 228)  3

a  At most one course in this sequence may double count to satisfy the Materials, Science, or Physical Chemistry elective requirement. This double counting does not reduce the total credit hour requirement for the degree; there are no restrictions on the additional course(s) used to meet the total credit requirement.
Statistics for Experimenters (STAT 313) or Basic Statistics for Engineering and Science (STAT 312) 3
Thermodynamics of Chemical Systems (ECHE 363) 3
Science elective g 3
Humanities/Social Science elective I ** 3
Year Total: 16 15

Third Year Units

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport Phenomena for Chemical Systems (ECHE 360) 4</td>
<td></td>
</tr>
<tr>
<td>Process Control (ECHE 367) 4</td>
<td></td>
</tr>
<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)** 4</td>
<td></td>
</tr>
<tr>
<td>Chemical Laboratory Methods for Engineers (CHEM 290) 3</td>
<td></td>
</tr>
<tr>
<td>Breadth elective sequence I e 3</td>
<td></td>
</tr>
<tr>
<td>Separation Processes (ECHE 361) 3</td>
<td></td>
</tr>
<tr>
<td>Chemical Reaction Processes (ECHE 364) 3</td>
<td></td>
</tr>
<tr>
<td>Measurements Laboratory (ECHE 365) 3</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGR 398)** 1</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGR 398)** 2</td>
<td></td>
</tr>
<tr>
<td>Humanities/Social Science elective II ** 3</td>
<td></td>
</tr>
<tr>
<td>Year Total: 18 15</td>
<td></td>
</tr>
</tbody>
</table>

Fourth Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Engineering Laboratory (ECHE 362) 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Analysis and Design (ECHE 398) 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials elective h 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breadth Elective Sequence II e 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humanities/Social Science elective III ** 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical Engineering Design Project (ECHE 399) j 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statics and Strength of Materials (ENGR 200) ** 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Chemistry elective d 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breadth elective sequence III e 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humanities/Social Science elective IV ** 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total: 16 15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Units in Sequence: 130

Hours required for graduation: 129-131 (depending on breadth elective sequence)

* University general education requirement
** Engineering general education requirement
c Higher number (advanced or honors) courses are available to students by invitation only.
e A three-course (9 credit hours minimum) breadth sequence, as described above.

g Science elective. One course chosen from:
  • PHYS 221 Introduction to Modern Physics
  • CHEM 224 Introductory Organic Chemistry II
  Or any 300 level or higher lecture-based course in Chemistry, Physics, Biology or Biochemistry

Note: The course used to satisfy the Science elective cannot double count towards the Materials or Physical Chemistry Elective requirements.

h Materials elective. One course chosen from:
  • EMAC 270 Introduction to Polymer Science and Engineering
  • EMAC 276 Polymer Properties and Design
  • EMSE 276 Materials Properties and Design
  • EMSE 343 Materials for Electronics and Photonics
  • BIOL 307 Introduction to Biochemistry: From Molecules To Medical Science
  Or any 300 level or higher lecture-based course in Materials Science and Engineering or Macromolecular Science and Engineering

Note: The course used to satisfy the Materials elective cannot double count towards the Science or Physical Chemistry Elective requirements.

i SAGES Capstone Course

j Physical Chemistry elective. One course chosen from:
  • CHEM 336 Physical Chemistry II
  • PHYS 221 Introduction to Modern Physics
  • PHYS 313 Thermodynamics and Statistical Mechanics
  • PHYS 331 Introduction to Quantum Mechanics I
  • BIOL 334 Structural Biology
  • EMSE 343 Materials for Electronics and Photonics
  • EECS 321 Semiconductor Electronic Devices

Note: The course used to satisfy the Physical Chemistry elective cannot double count towards the Science or Materials Elective requirements.

Biochemical Engineering Concentration

Biochemical engineering can be defined as the field of application of chemical engineering principles to systems that utilize biomolecules or bio-organisms to bring forth biotransformation. Biochemical engineering applications are versatile, ranging from waste-water treatment to production of therapeutic proteins. For the biochemical engineering concentration, students select the elective courses as described below, and take two additional courses:

Materials Elective: BIOL 307

Science Elective: BIOL 300

Physical Chemistry Elective: BIOL 334

Breadth Elective Sequence: Biochemical Engineering sequence (described above)

Must also take

| BIOL 382 | Drugs, Brain, and Behavior |
| PHRM 309 | Principles of Pharmacology |

Pre-Medical Concentration

By using the flexibility provided by science and technical electives in the curriculum, students are able to pursue courses that provide the
background needed for medical school. Students choose the following electives to meet the course requirements of most medical schools.

Materials Elective: BIOC 307
Science Elective: CHEM 224 or CHEM 324
Chemistry Labs: CHEM 113 and CHEM 233 and CHEM 234 instead of CHEM 290
Breadth Elective Sequence: Pre-Medical sequence (described above)

Co-op and Internship Programs (http://engineering.case.edu/coop)
Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

Five-Year Combined BS/MS Program
Outstanding undergraduate students have the opportunity to obtain an MS degree, with a thesis, in one additional year of study beyond the BS degree. (Normally, it takes two years beyond the BS to earn an MS degree.) In this program, an undergraduate student can take up to nine hours of graduate credit that simultaneously satisfies undergraduate degree requirements. Typically, students in this program start their research leading to the MS thesis in the fall semester of the senior year. The BS degree is awarded at the completion of the senior year. Application for admission to the five-year BS/MS program is made after completion of five semesters of coursework. Minimum requirements are a 3.2 grade point average and the recommendation of the department. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

Five-and-a Half Year Cooperative BS/MS Program
The cooperative bachelor’s/master’s program enables outstanding students who are enrolled in the cooperative education program to earn an MS in one semester beyond the BS degree. Students complete six credits of a graduate project (ECHE 660) during the second co-op period and follow an Advanced Study elective sequence. Up to nine credits of graduate coursework can be used to satisfy both graduate and undergraduate requirements. At the end of the fifth year, the student receives the BS degree. Upon completion of an additional 12 credits of graduate work the following semester, the student receives the MS degree (non-thesis). Application for admission to the five-and-a-half-year co-op BS/MS program is made during the second semester of the junior year (this semester is taken in the fall of the fourth year). Minimum requirements are a 3.2 grade point average, satisfactory performance in the previous co-op assignment, and the recommendation of the department.

Minor in Chemical Engineering
The minor in chemical engineering is for students majoring in other disciplines. A minimum of 17 hours in chemical engineering courses are required for the minor. The required courses are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 225</td>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer</td>
<td>4</td>
</tr>
<tr>
<td>ECHE 260</td>
<td>Introduction to Chemical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECHE 360</td>
<td>Transport Phenomena for Chemical Systems</td>
<td>4</td>
</tr>
<tr>
<td>Plus two courses selected from the following:</td>
<td>6-7</td>
<td></td>
</tr>
<tr>
<td>ECHE 361</td>
<td>Separation Processes</td>
<td></td>
</tr>
<tr>
<td>ECHE 363</td>
<td>Thermodynamics of Chemical Systems</td>
<td></td>
</tr>
<tr>
<td>ECHE 364</td>
<td>Chemical Reaction Processes</td>
<td></td>
</tr>
<tr>
<td>ECHE 365</td>
<td>Measurements Laboratory</td>
<td></td>
</tr>
<tr>
<td>ECHE 367</td>
<td>Process Control</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>17-18</td>
</tr>
</tbody>
</table>

Graduate Programs
Master of Science Program
Each MS candidate must complete a minimum of 27 hours of graduate-level credits. These credits can be distributed in one of two ways, Plan A or Plan B.

Plan A
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECHE 401</td>
<td>Chemical Engineering Communications</td>
<td>1</td>
</tr>
<tr>
<td>Six graduate-level courses(^a)</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>MS thesis research</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>28</td>
</tr>
</tbody>
</table>

or

Plan B
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eight graduate-level courses(^a)</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Project and/or Special Problems(^b)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>27</td>
</tr>
</tbody>
</table>

\(^a\) Some of the graduate-level courses must be taken from a list of recommended courses that satisfy the Chemical Engineering core ‘units’ requirement. The list is maintained by the department. For the MS program, students should demonstrate that they have acquired a minimum of three core ‘units’ in each of the categories of Chemical Engineering Transport, Thermodynamics and Reactions. Elective courses should be technical graduate-level courses selected after consultation with the advisor.

\(^b\) In special cases, a student may be permitted to complete a 6 credit project. In this case, only seven graduate courses will be required.

Full-time MS students are expected to serve as a teaching assistant as part of their education. Also, at various points during their thesis research, students will be required to present seminars and reports on their progress.
Doctor of Philosophy Program

The degree of Doctor of Philosophy is awarded in recognition of deep and detailed knowledge of chemical engineering and a comprehensive understanding of related subjects together with a demonstration of the ability to perform independent research, to suggest new areas for research, and to communicate results in an acceptable manner. For students entering the PhD program with a BS degree, a total of 12 courses (36 credit hours) is required. Course requirements for students entering with MS degrees are adjusted to account for work done at other universities, but a minimum of 6 courses (18 credit hours) must be taken at CWRU. The course requirements for students entering with a BS degree are as follows:

<table>
<thead>
<tr>
<th>Course Type</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core and Elective courses</td>
<td>30</td>
</tr>
<tr>
<td>Professional Development courses</td>
<td>6</td>
</tr>
<tr>
<td>PhD thesis research</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total Units</strong></td>
<td>54</td>
</tr>
</tbody>
</table>

a Some of the graduate-level courses should be taken from a list of recommended courses that satisfy the Chemical Engineering core ‘units’ requirement. This list will be provided to the students upon admission to the program. For the PhD program, students should demonstrate that they have acquired a minimum of three core ‘units’ in each of the categories of Chemical Engineering Transport, Thermodynamics, Reactions and Applied Mathematics.

b Professional development is an integral part of the PhD program of study. The 6 professional development credits are acquired through courses in Chemical Engineering Communications (3 total credits), and by attending the Chemical Engineering Colloquium (3 total credits). All PhD students are required to assist in three teaching experiences as part of their degree requirements.

c Students in the PhD program are required to complete 18 credits of thesis research. Also, students who enter the PhD program must pass a First Proposition Oral Examination (with an accompanying written report) that tests a student’s ability to think creatively, grasp new research concepts, and discuss such concepts critically and comprehensively. The First Proposition Exam, typically taken in the Fall semester of the second year, serves as the qualifying examination for the PhD degree. A Second Proposition Exam focusing on the student’s own research topic is required by the end of the second year in the PhD program. All PhD students must satisfy the residency requirements of the university and the Case School of Engineering. In addition, at various points in the course of the dissertation research, students will be required to prepare reports and seminars on their work, and defend their dissertation. The Chemical and Biomolecular Engineering Graduate Student Handbook contains a more detailed description of the department’s PhD requirements and a time schedule for their completion.

The department anticipates that from time to time, special cases will arise which are exceptions to the above guidelines, e.g., a student may have taken a graduate-level course at another school. In these cases, the student must submit a statement with the Planned Program of Study justifying the departure from the guidelines and have it approved by the department.

Facilities

The department is housed in the Albert W. Smith Building and portions of the Bingham Building on the Case Quadrangle. Professor Smith was chair of industrial chemistry at Case from 1911 to 1927. Under his leadership a separate course of study in chemical engineering was introduced at Case in 1913. Professor Smith was also a close associate of Herbert Dow, the Case alumnus who founded Dow Chemical in 1890 with the help and support of Professor Smith. The Albert W. Smith Chemical Engineering Building contains one technology enhanced classroom; the undergraduate Unit Operations Laboratory; an undergraduate reading room, named after Prof. Robert V. Edwards; and the normal complement of offices and research laboratories. The lobby of the A.W. Smith Building, renovated by contributions from the James family, often serves as a formal and informal gathering place for students and faculty. The department has exceptionally strong facilities for electrochemical and energy research, for microfabrication, and for chemical vapor deposition and thin film synthesis. In addition, a full range of biochemical, analytical and materials characterization instrumentation is available in the Case School of Engineering. Analytical instrumentation is available within the Department of Chemical and Biomolecular Engineering, the Department of Chemistry, and the Materials Research Laboratory.

Faculty

Daniel Lacks, PhD  
(Harvard University)

C. Benson Branch Professor of Chemical Engineering, Department Chair

Molecular simulation, statistical mechanics, triboelectric charging

Rohan N. Akolkar, PhD  
(Case Western Reserve University)

Associate Professor and F. Alex Nason Chair

Electrochemical phenomena in next-generation batteries, photovoltaics and semiconductor devices

John C. Angus, PhD  
(University of Michigan)

Emeritus Professor

Chemical vapor deposition of diamond, electrochemistry of diamond, gallium nitride synthesis

Harihara Baskaran, PhD  
(The Pennsylvania State University)

Professor

Transport phenomena in biology and medicine

Donald L. Feke, PhD  
(Princeton University)

Distinguished University Professor and Vice Provost for Undergraduate Education

Colloidal and transport phenomena, dispersive mixing, particle science and processing

Burcu Gurkan, PhD  
(University of Notre Dame)

Assistant Professor

Energy storage, nonflammable electrolytes, electrode fabrication, electrochemical separation processes
Courses

ECHE 151. Introduction to Chemical Engineering at Case. 1 Unit.
An introduction to the profession of chemical engineering, its practice in industry, and review of the challenges and opportunities for the profession. The academic programs and curricular enhancements available to students majoring in chemical engineering at CWRU, including breadth sequence sequences and concentrations, undergraduate research, international study opportunities, cooperative education and internships, are presented. In addition to introducing the chemical engineering faculty and their research, a number of guest speakers representing the broad professional opportunities discuss career options with the students. Through lectures and discussions, students are also introduced to topics such as professionalism and ethics. Upperclassmen students conduct their co-op debriefing in the class, sharing experiences and initiating networking. In the lab/recitation section, students in smaller groups conduct experiments on chemical processes, spanning different aspects of the profession, and run computer-based simulations of those experiments. Analysis and discussion of the results will follow. Chemical engineering upperclassmen serve as teaching assistants.

ECHE 250. Honors Research I. 1 - 3 Units.
A special program which affords a limited number of students the opportunity to conduct research under the guidance of one of the faculty. At the end of the first semester of the sophomore year, students who have a strong interest in research are encouraged to discuss research possibilities with the faculty. Assignments are made based on mutual interest. Subject to the availability of funds, the faculty employs students through the summers of their sophomore and junior years, as members of their research teams.

ECHE 251. Honors Research II. 1 - 3 Units.
(See ECHE 250.) Recommended preparation: ECHE 250.

ECHE 260. Introduction to Chemical Systems. 3 Units.
Material and energy balances. Conservation principles and the elementary laws of physical chemistry applied to chemical processes. Developing skills in quantitative formulation and solution of word problems. Prereq: CHEM 111, ENGR 145 and MATH 122.

ECHE 305. Topics in Chemical Engineering. 0 Unit.
Topics in chemical engineering will be covered in an independent study mode. Readings and homework assignments will be assigned. Students are graded on the basis of homework assignments and a final exam.

ECHE 340. Biochemical Engineering. 3 Units.
Chemical engineering principles applied to biological and biochemical systems and related processes. Microbiology and biochemistry linked with transport phenomena, kinetics, reactor design and analysis, and separations. Specific examples of microbial and enzyme processes of industrial significance. Recommended preparation: BIOM 307, BIOL 343 and ECHE 364, or permission of instructor.

ECHE 350. Undergraduate Research Project I. 3 Units.
This course affords a student the opportunity to conduct research under the guidance of one of the faculty, as part of the Chemical Engineering Research breadth elective sequence. Students who have a strong interest in research are encouraged to discuss research possibilities with the faculty. Assignments are made based on mutual interest.
ECHE 351. Undergraduate Research Project II. 3 Units.
This course affords a student the opportunity to conduct research under the guidance of one of the faculty, as part of the Chemical Engineering Research breadth elective sequence. Students who have a strong interest in research are encouraged to discuss research possibilities with the faculty. Assignments are made based on mutual interest. Prereq: ECHE 350.

ECHE 355. Quantitative Molecular, Cellular and Tissue Bioengineering. 3 Units.
Physical and chemical principles associated with kinetics and mass transport. Molecular-cellular components incorporated in quantitative analysis of cellular, tissue, and organ systems. Mathematical and computational modeling developed for diagnostic and therapeutic applications. Offered as EBME 350 and ECHE 355.

ECHE 360. Transport Phenomena for Chemical Systems. 4 Units.
Fundamentals of fluid flow, heat and mass transport from the microscopic and macroscopic perspectives. Applications to chemical systems, including steady and transient operations, convective and molecular (conduction and diffusion) effects, and interfacial transport. Design of unit operations (e.g., heat exchangers). Heat and mass transfer analogies. Vector/tensor analysis and dimensional analysis used throughout. Prereq: ENGR 225 and MATH 223.

ECHE 361. Separation Processes. 3 Units.
Analysis and design of separation processes involving distillation, extraction, absorption, adsorption, and membrane processes. Design problems and the physical and chemical processes involved in separation. Equilibrium stage, degrees of freedom in design, graphical and analytical design techniques, efficiency and capacity of separation processes. Prereq: ECHE 260. Prereq or Coreq: ECHE 363.

ECHE 362. Chemical Engineering Laboratory. 4 Units.
Experiments in the operation of separation and reaction equipment, including design of experiments, technical analysis, and economic analysis. Experiments cover distillation, liquid-liquid extraction, heat transfer, fluidized beds, control, membrane separations, and chemical and electrochemical reactors. Prereq: ECHE 260, ECHE 360, ECHE 361, ECHE 363 and ECHE 364.

ECHE 362D. Chemical Engineering Laboratory in Denmark. 4 Units.
Chemical Engineering Laboratory in Denmark. A version of ECHE 362 taught during the summer at DTU in Lyngby. Prereq: ECHE 260 and ECHE 360 and ECHE 361 and ECHE 363 and ECHE 364.

ECHE 363. Thermodynamics of Chemical Systems. 3 Units.
First law, second law, phase equilibria, phase rule, chemical reaction equilibria, and applications to engineering problems. Thermodynamic properties of real substances, with emphasis on solutions. Thermodynamic analysis of processes including chemical reactions. Prereq: ECHE 260 and Prereq or Coreq: ENGR 225.

ECHE 364. Chemical Reaction Processes. 3 Units.

ECHE 365. Measurements Laboratory. 3 Units.
Laboratory introduction to the measurement process in engineering. Matching measurements to approximate and exact physical models is stressed. Extraction of physical parameters and estimation of the errors in the parameter estimates is an important part of the course. Example projects cover steady and unsteady state heat transfer, momentum transfer, and the first law of thermodynamics. Recommended preparation: ECHE 360. Prereq: ECHE 260 and ENGR 225. Prereq or Coreq: ECHE 363.

ECHE 367. Process Control. 4 Units.
Theoretical and practical aspects of feedback control of chemical processes. The course involves extensive use of computer software with some exams taken using the computer. Short laboratories and Labview training are integrated into the course. Topics include: analysis of linear dynamical systems using Laplace transforms, derivation of unsteady state mathematical models of simple chemical processes, dynamic simulation of linear and nonlinear models, design of PID controllers by model inverse methods, tuning of controller to accommodate process model uncertainty, two degrees of freedom controllers, feed-forward and cascade control. The Labview training covers programming basics, interfacing to a data acquisition system, and incorporating control algorithms. Prereq: MATH 224. Prereq or Coreq: ECHE 260.

ECHE 377. Data Acquisition and LabVIEW Bootcamp. 1 Unit.
This course will introduce and implement basic data acquisition concepts and LabVIEW virtual instrumentation programming, providing hands-on experience with hardware and software. It is intended to help those with little or no data acquisition experience to get started on setting up data acquisition for their application. No prior experience with LabVIEW is required. Consult with the instructor for additional details. Offered as ECHE 377 and ECHE 477.

ECHE 381. Electrochemical Engineering. 3 Units.
Engineering aspects of electrochemical processes including current and potential distribution, mass transport and fluid mechanical effects. Examples from industrial processes including electroplating, industrial electrolysis, corrosion, and batteries. Recommended preparation: ECHE 260 or permission of instructor. Offered as ECHE 381 and ECHE 480.

ECHE 383. Chemical Engineering Applied to Microfabrication and Devices. 3 Units.
Silicon based microfabrication and micromachining require many chemical engineering technologies. Microfabricated devices such as sensors are also directly related to chemical engineering. The applications of chemical engineering principles to microfabrication and micromachining are introduced. Oxidation processing, chemical vapor deposition, etching and patterning techniques, electroplating and other technologies are discussed. Graduate students will submit an additional final project on some technical aspect of microfabrication technology or devices. Recommended preparation: ECHE 363 and ECHE 371. Offered as ECHE 383 and ECHE 483.

ECHE 397. Special Topics in Chemical Engineering. 3 Units.
Special topics within an area of chemical engineering.
ECHE 398. Process Analysis and Design. 3 Units.
ECHE 399. Chemical Engineering Design Project. 3 Units.
This is a course that uses the small teams approach to solve chemical process design problems. Numerous exercises involving process design are used to integrate material taught in previous and concurrent courses. This includes application of computer based design tools, economics, scheduling, decision making with uncertainty, and proposal and report preparation. This work leads to one comprehensive process design project done by the class, which includes a written and oral report. Recommended preparation: ECHE 362 and ECHE 398. Counts as SAGES Senior Capstone. Prereq: ECHE 360, ECHE 361, ECHE 364, ECHE 365, and ECHE 367.

ECHE 400T. Graduate Teaching I. 0 Unit.
All Ph.D. students are required to take this course. The experience includes elements from the following tasks: development of teaching or lecture materials, teaching recitation groups, providing laboratory assistance, tutoring, exam/quiz/homework preparation and grading, mentoring students. Recommended preparation: Entering Ph.D. student in Chemical Engineering.

ECHE 401. Chemical Engineering Communications. 1 Unit.
Introductory course in communication for Chemical Engineering graduate students: preparation of first proposal for thesis, preparation of technical reports and scientific papers, literature sources, reviewing proposals, and manuscripts for professional journals, and making effective technical presentations.

ECHE 402. Chemical Engineering Communications II. 2 Units.
This course is a continuation of ECHE 401 and is designed to develop skills in writing proposals for funding research projects. The federal requirements are reviewed for submitting proposals to the major granting agents including NSF, NIH and DoD. We will study strategies for developing fundable projects. Each student will submit a research proposal for a thesis project and do an oral presentation of the project.

ECHE 460. Thermodynamics of Chemical Systems. 3 Units.
Phase equilibria, phase rule, chemical reaction equilibria in homogeneous and heterogeneous systems, ideal and non-ideal behavior of fluids and solutions, thermodynamic analysis of closed and open chemical systems with applications. Recommended preparation: ECHE 363.

ECHE 461. Transport Phenomena. 3 Units.

ECHE 462. Chemical Reaction Engineering. 3 Units.

ECHE 464. Surfaces and Adsorption. 3 Units.
Thermodynamics of interfaces, nature of interactions across phase boundaries, capillary wetting properties of adsorbed films, friction and lubrication, flotation, detergency, the surface of solids, relation of bulk to surface properties of materials, non-catalytic surface reactions. Recommended preparation: CHEM 335 or equivalent.

ECHE 465. Biotransport Processes. 3 Units.
This course will introduce and implement basic data acquisition concepts and LabVIEW virtual instrumentation programming, providing hands-on experience with hardware and software. It is intended to help those with little or no data acquisition experience to get started on setting up data acquisition for their application. No prior experience with LabVIEW is required. Consult with the instructor for additional details. Offered as ECHE 381 and ECHE 480.

ECHE 466. Colloid Science. 3 Units.

ECHE 469. Chemical Engineering Seminar. 0 Unit.
Distinguished outside speakers present current research in various topics of chemical engineering science. Graduate students also present technical papers based on thesis research.

ECHE 470. Graduate Research Colloquium. .5 Unit.
Outside speakers present lectures on their current research. Various topics in the areas of chemical engineering science, basic and applied chemistry, bioengineering, material science, and applied mathematics are covered in the lectures. Graduate students also present technical papers based on their own research. Students are graded on the submission of one-page summary reports on any two lectures.

ECHE 472. Electrochemical Energy Storage. 3 Units.
Batteries and supercapacitors as part of renewable energy systems are introduced. Related fundamental electrochemistry concepts, materials and techniques are described. Challenges, current literature and future opportunities in energy storage will be discussed. Prereq: Graduate standing or requisites not met permission.

ECHE 474. Biotransport Processes. 3 Units.
Biomedical mass transport and chemical reaction processes. Basic mechanisms and mathematical models based on thermodynamics, mass and momentum conservation. Analytical and numerical methods to simulate in vivo processes as well as to develop diagnostic and therapeutic methods. Applications include transport across membranes, transport in blood, tumor processes, bioreactors, cell differentiation, chemotaxis, drug delivery systems, tissue engineering processes. Recommended preparation: EBME 350 or equivalent. Offered as EBME 474 and ECHE 474.

ECHE 475. Chemical Engineering Analysis. 3 Units.

ECHE 477. Data Acquisition and LabVIEW Bootcamp. 1 Unit.
This course will introduce and implement basic data acquisition concepts and LabVIEW virtual instrumentation programming, providing hands-on experience with hardware and software. It is intended to help those with little or no data acquisition experience to get started on setting up data acquisition for their application. No prior experience with LabVIEW is required. Consult with the instructor for additional details. Offered as ECHE 377 and ECHE 477.

ECHE 480. Electrochemical Engineering. 3 Units.
Engineering aspects of electrochemical processes including current and potential distribution, mass transport and fluid mechanical effects. Examples from industrial processes including electroplating, industrial electrolysis, corrosion, and batteries. Recommended preparation: ECHE 260 or permission of instructor. Offered as ECHE 381 and ECHE 480.
ECHE 481. Corrosion Fundamentals. 3 Units.
This course will cover fundamentals of corrosion, including thermodynamic and kinetic aspects of the electrochemical reactions leading to corrosion. Salient features of the various types of corrosion will be reviewed, with an emphasis on fundamental mechanisms. Electrochemical testing, corrosion monitoring and techniques to stifle corrosion will be discussed. After completion of this course, students will be able to classify corrosion systems, understand the mechanisms underlying corrosion, and outline strategies to design corrosion-resistant systems.

ECHE 483. Chemical Engineering Applied to Microfabrication and Devices. 3 Units.
Silicon based microfabrication and micromachining require many chemical engineering technologies. Microfabricated devices such as sensors are also directly related to chemical engineering. The applications of chemical engineering principles to microfabrication and micromachining are introduced. Oxidation processing, chemical vapor deposition, etching and patterning techniques, electroplating and other technologies are discussed. Graduate students will submit an additional final project on some technical aspect of microfabrication technology or devices. Recommended preparation: ECHE 363 and ECHE 371. Offered as ECHE 383 and ECHE 483.

ECHE 486. Protein Engineering. 3 Units.
This course will provide an in-depth examination of protein engineering topics and their applications. In particular, this class will cover the design and expression of recombinant proteins, purification strategies, and the incorporation of non-natural amino acids using a bacterial system. Specifically, amino acid sequences that dictate well-defined secondary structures such as beta-sheets, alpha-helices, and leucine zippers will be studied. We will examine recent tissue engineering examples from the literature such as incorporation of bioactive sequences to promote specific cell response (e.g., cell adhesion sites and protease degradation sequences). In addition, this course will explore the application of protein engineering in drug delivery, electrochemical technology, sensors, and nanoparticle assembly. Current computational techniques for protein design and directed evolution methods will also be explored. This class will emphasize primary literature papers and will expose students to the newest technologies being developed in these fields. Recommended preparation: ECHE 363. Prereq: Graduate standing or requisites not met permission.

ECHE 500T. Graduate Teaching II. 0 Unit.
All Ph.D. students are required to take this course. The experience will include elements from the following tasks: development of teaching or lecture materials, teaching recitation groups, providing laboratory assistance, tutoring, exam/quiz/homework preparation and grading, mentoring students. Recommended preparation: Ph.D. student in Chemical Engineering.

ECHE 508. Seminar on Review of Literature on Research Topic. 3 Units.
Impactful research requires a deep and comprehensive understanding of the current state of research on the topic. A critical review of relevant background literature will help determine what is already known on the topic, how extensively the topic has already been studied, who are the experts active in the field, and the relevant key questions that deserve further exploration. A review of the literature that describes methodologies (both experimental and theoretical) used in prior studies or new approaches that could be adapted from other research areas can also lead to the effective pursuit of the research topic. Through this course, students will learn how to develop a plan for a literature review, conduct the literature review and monitor continuing developments in the field, and create an annotated bibliography appropriate to the research project.

ECHE 509. Seminar on Preparation of Articles for Publication in Journals. 3 Units.
This course is intended for advanced graduate students who have generated results at the stage of being ready to be written up for a journal article. The course will cover: understanding what findings warrant publication, factors affecting journal selection, formatting requirements of journals, publication-quality figures, appropriate material for each of the sections of the paper. During the course students will be putting together a manuscript based on their research that would eventually be submitted to a journal.

ECHE 580. Special Topics. 3 Units.
Special topics in chemical engineering. Prereq: Consent of instructor.

ECHE 590. Topics in Materials Engineering. 3 Units.
Seminar course focusing on topics related to materials engineering. Typical subjects include processing and properties of electronic and nanomaterials, composites and dispersions; mixing of particles and agglomerates; electrodeposition of alloys; molecular level simulations. Students will be assigned readings from book chapters, classical articles and state of the art publications. A discussion leader (pre-assigned) will be responsible for introducing the papers and leading a critical discussion. Active student participation in the discussions is expected.

ECHE 600T. Graduate Teaching III. 0 Unit.
All Ph.D. students are required to take this course. The experience will include elements from the following tasks: development of teaching or lecture materials, teaching recitation groups, providing laboratory assistance, tutoring, exam/quiz/homework preparation and grading, mentoring students. Recommended preparation: Ph.D. student in Chemical Engineering.

ECHE 601. Independent Study. 1 - 18 Units.

ECHE 651. Thesis M.S.. 1 - 18 Units.
Research course taken by Plan B M.S. students.

ECHE 660. Special Problems. 1 - 18 Units.

ECHE 695. Project M.S.. 1 - 9 Units.
Research course taken by Plan B M.S. students. Prereq: Enrolled in ECHE Plan B Program.

ECHE 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Civil Engineering

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David Zeng, Frank H. Neff Professor and Chair
xiangwu.zeng@case.edu

The Department of Civil Engineering offers programs of study in environmental, geotechnical, and structural engineering, construction engineering and management, and engineering mechanics.

Civil engineers plan, design, and construct facilities for meeting the needs of modern society. Civil engineers also help to reduce the environmental impact of these designs to help make modern society more sustainable. Examples of such facilities are transportation systems, schools and office buildings, bridges, dams, land reclamation projects, water treatment and distribution systems, commercial buildings, and industrial plants. Civil engineers can choose from a broad spectrum of opportunities in industry and consulting practice as well as research and development in firms in which civil engineers often participate as owners or partners. Employment can be found among a wide variety of industrial, governmental, construction, and private consulting organizations. There is a large demand for civil engineers nationally. The program at Case Western Reserve University is built around small classes, good faculty-student relationships and advising, and a program flexible enough to meet students’ personal career goals.

The Department of Civil Engineering of the Case School of Engineering offers a Bachelor of Science degree in Civil Engineering with courses in almost all the traditional Civil Engineering subjects. The graduate program offers the Master of Science and Doctor of Philosophy degrees in areas of structural, geotechnical, environmental engineering, and engineering mechanics. A cooperative education program involving participating engineering firms is also available for both undergraduate and graduate students.

The Department’s active research programs provide opportunities for students to participate in projects related to design, analysis, and testing. Projects are in areas such as computational mechanics, probabilistic design, bridges, dynamics and wind engineering, response of concrete and steel structures, fracture mechanics, blast engineering, structural health monitoring, foundation engineering, static and dynamic behavior of soils, earthquake engineering, pavement engineering, subsurface and ex situ remediation, urban hydraulics, contaminated sediments, infrastructure materials, and infrastructure systems optimization.

Mission

The Department of Civil Engineering has developed its own mission statement and educational objectives that are consistent with those of the Case School Engineering. This process involved the entire Civil Engineering faculty and the Department’s Civil Engineering Advisory Committee and alumni. Assessing the Department’s mission and educational objectives is an ongoing process.

Our mission is to prepare students for leadership roles in Civil and Environmental Engineering. The Department will provide facilities and research expertise to advance the state of the Civil Engineering profession within the mission of the Case School of Engineering. Students will be taught to address problems building on solid technical foundations while taking advantage of advanced technologies. Our graduates will adhere to high technical and ethical standards, in service to the public. Graduates will be prepared for the pursuit of advanced learning in civil engineering and related fields, as well as for the practice of Civil and Environmental Engineering at the highest professional levels.

Research

Research under way in Civil Engineering includes work in analytical, design and experimental areas and is sponsored by industry, state, and federal government sources. Major areas of research interest are:

- Behavior of reinforced and prestressed concrete
- Wind engineering
- Earthquake analysis and design of structures
- Finite element methods
- Nondestructive Testing of Structures
- Passive control of the vibration of structures
- Transient response of nonlinear structures
- Blast loading of structures
- Fracture mechanics
- Multiscale simulation of nonlinear dynamic structural behavior
- Modeling of structural materials and structural systems
- High and low-cycle fatigue
- Geotechnical/Pavement Materials
- Static behavior of anisotropic clays and sands
- Soil liquefaction
- Centrifuge modeling of static and dynamic soil behavior
- Dynamic soil structure interaction
- Non-destructive testing evaluation of soils and pavement materials
- Measurement of dynamic soil properties
- Design of Structures for High-Speed Vehicles
- Stability of tailings dams
- Environmentally conscious manufacturing
- Brownfields/structural remediation
- Environmental modeling and software development
- Geoenvironmental engineering
- Sediment remediation
- Environmental chemistry
- Bioremediation
- Structural health monitoring
- Transportation safety
- Infrastructure engineering
- Non-destructive Testing
- Sensor technology
- Smart materials
- Energy structures and geotechnology
- Biofuel development
- Urban hydraulics
- Soil contamination standards
- Intelligent infrastructure and transportation system
- Driver safety
- Building materials
- Environmental hazard and risk engineering
- Extreme dynamic load resistant design
- Multi-hazard and structural risk assessment

Undergraduate Programs

The faculty of the Civil Engineering Department believe very strongly that undergraduate education should prepare students to be productive
professional engineers. For this reason, particular emphasis in undergraduate teaching is placed on the application of engineering principles to the solution of problems. After completing a broad Civil Engineering core program, undergraduate students choose an elective sequence in one of the areas of civil engineering of particular interest, such as structural, geotechnical, or environmental engineering; construction management or engineering mechanics.

In order to provide undergraduates with experience in the practice of Civil Engineering, the department attempts to arrange summer employment for students during the three summers between their semesters at Case Western Reserve University. By working for organizations in areas of design and construction, students gain invaluable knowledge about how the profession functions. This experience helps students gain more from their education and helps them be more more competitive when seeking future employment.

A cooperative education program is also available. This allows the student to spend time an extended period of time working full-time in an engineering capacity with a contractor, consulting engineer, architect, or materials supplier during the course of his or her education. This learning experience is designed to integrate classroom theory with practical experience and professional development.

The Bachelor of Science degree program in Civil Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

The curriculum has been designed so that students choose a sequence of four (4) or more approved elective courses. The sequence gives students the opportunity to pursue in more depth a particular area of practice into Civil Engineering. Samples of courses from which elective sequences may be chosen follow the Civil Engineering curriculum in this bulletin. In addition, all Civil Engineering students participate in a team senior capstone design course which provides them experience with solving multidisciplinary Civil Engineering problems.

Students enrolled in other majors may pursue a minor in civil engineering. A minimum of 15 credit hours of Civil Engineering courses and prior Department minor advisor approval are required.

Most classes in the Civil Engineering Department have enrollment of less than 25 so the students have opportunities to develop close professional relationships with the faculty. Students also have opportunities to gain practical experience as well as earn a supplemental income by assisting faculty members on consulting work or a funded research project.

**Program Educational Objectives**

1. Graduates of the ECIV Program will enter the profession of Civil Engineering and advance to greater responsibility and leadership, in line with ASCE Professional Grade Descriptions.
2. Graduates of the ECIV Program will enter and successfully progress in, or complete, advanced degree programs within their fields of choice.
3. Graduates of the ECIV Program will progress toward or complete professional registration and licensure.

**Student Outcomes**

As preparation for achieving the above educational objectives, the BS degree program in Civil Engineering is designed so that students attain:

- an ability to apply knowledge of mathematics (including differential equations) and science (including calculus-based physics and general chemistry) and one additional area of science.
- an ability to design and conduct experiments, as well as to analyze and interpret data in more than one area of civil engineering.
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- an ability to function on multi-disciplinary teams.
- an ability to identify, formulate, and solve engineering problems.
- an understanding of professional and ethical responsibility and the role of civil engineers in providing for the safety and well-being of the general public.
- an ability to communicate effectively in written and oral form.
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- a recognition of the need for, and an ability to engage in life-long learning.
- a knowledge of contemporary issues.
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice and the design of functional civil engineering facilities.
- proficiency in probability and statistics, as applied to civil engineering design and planning issues.
- an understanding of professional practice issues, including the role of civil engineering design and management professionals in the construction process, public policy and leadership.
- an ability to develop an understanding of the importance of professional licensure and the ethical use of a professional license.

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### Bachelor of Science in Engineering

**Required Courses: Major in Civil Engineering**

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECIV 160</td>
<td>Surveying and Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 211</td>
<td>Civil Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 310</td>
<td>Strength of Materials</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 320</td>
<td>Structural Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 322</td>
<td>Structural Design I</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 330</td>
<td>Soil Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>ECIV 340</td>
<td>Construction Management</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 351</td>
<td>Engineering Hydraulics and Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 360</td>
<td>Civil Engineering Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 368</td>
<td>Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 398</td>
<td>Civil Engineering Senior Project</td>
<td>3</td>
</tr>
</tbody>
</table>

**Related Required Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAE 181</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 250</td>
<td>Computers in Mechanical Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>
A minimum of four courses from one of the following technical elective sequences (or alternatives approved by the student’s academic advisor), two of which must be from Civil Engineering and two of which must be designated as design courses (indicated with an *)

### Structural Engineering
- ECIV 321: Matrix Analysis of Structures
- ECIV 323: Structural Design II (*)
- ECIV 411: Elasticity, Theory and Applications (*)
- ECIV 420: Finite Element Analysis
- ECIV 421: Advanced Topics in Reinforced Concrete Structures (*)
- ECIV 422: Advanced Structural Steel Design (*)
- ECIV 423: Prestressed Concrete Design
- ECIV 424: Structural Dynamics
- ECIV 425: Structural Design for Dynamic Loads (*)
- ECIV 426: Probabilistic Analysis
- ECIV 430: Foundation Engineering (*)
- ECIV 456: Intelligent Infrastructure Systems

### Geotechnical Engineering
- ECIV 323: Structural Design II (*)
- ECIV 411: Elasticity, Theory and Applications
- ECIV 420: Finite Element Analysis
- ECIV 430: Foundation Engineering (*)
- ECIV 431: Special Topics in Geotechnical Engineering
- ECIV 432: Mechanical Behavior of Soils
- ECIV 433: Soil Dynamics
- ECIV 437: Pavement Analysis and Design (*)
- EEPS 330: Geophysical Field Methods and Laboratory

### Engineering Mechanics
- ECIV 411: Elasticity, Theory and Applications
- ECIV 420: Finite Element Analysis
- ECIV 422: Advanced Structural Steel Design (*)
- ECIV 424: Structural Dynamics
- ECIV 432: Mechanical Behavior of Soils

### Environmental Engineering
- ECIV 361: Water Resources Engineering (*)
- ECIV 362: Solid and Hazardous Waste Management (*)
- ECIV 450: Environmental Engineering Chemistry
- ECIV 460: Environmental Remediation (*)
- ECIV 461: Environmental Engineering Biotechnology (*)
- EEPS 220: Environmental Geology
- Pre-Architecture
  - ARTS 106: Creative Drawing I
  - ARTS 206: Creative Drawing II
  - ARTS 302: Architecture and City Design I
  - ARTS 304: Architecture and City Design III
  - ECIV 323: Structural Design II
  - ECIV 421: Advanced Topics in Reinforced Concrete Structures (*)
  - ECIV 430: Foundation Engineering (*)

### Construction Engineering and Management
- BAFI 355: Corporate Finance
- ECIV 341: Construction Scheduling and Estimating
- ECIV 430: Foundation Engineering (*)
- ECON 369: Economics of Technological Innovation and Entrepreneurship
- ECON 368: Environmental Economics
- ECIV 437: Pavement Analysis and Design (*)

Computer use is an integral part of the Civil Engineering curriculum. From required courses in computer programming and numerical analysis to subsequent use and development of Civil Engineering programs, students experience the use of computers as a planning, analysis, design, and managerial tools.

All sequences are constructed to provide a balance of marketable skills and theoretical bases for further growth. With departmental approval other sequences can be developed to meet students’ needs.

## Bachelor of Science in Engineering

### Suggested Program of Study: Major in Civil Engineering

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

#### First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary Computer Programming (ENGR 131)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSXX SAGES First Seminar*</td>
<td>4</td>
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<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHED (two half semester classes)*</td>
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</tr>
<tr>
<td>SAGES University Seminar I</td>
<td>3</td>
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<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
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<tr>
<td>Calculus for Science and Engineering II (MATH 122)**</td>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>General Physics I - Mechanics (PHYS 121)**</td>
<td>4</td>
<td></td>
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<tr>
<td>PHED (two half semester classes)*</td>
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<tr>
<td>Year Total:</td>
<td>18</td>
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#### Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGES University Seminar II*</td>
<td>3</td>
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<tr>
<td>Surveying and Computer Graphics (ECIV 160)</td>
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<tr>
<td>Computers in Mechanical Engineering (EMAE 250)</td>
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<tr>
<td>Statics and Strength of Materials (ENGR 200)**</td>
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<tr>
<td>Calculus for Science and Engineering III (MATH 223)**</td>
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<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)**</td>
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</tbody>
</table>
Humanities or Social Science**  3
Strength of Materials (ECIV 310)  3
Dynamics (EMAE 181)  3
Introduction to Circuits and Instrumentation (ENGR 210)**  4
Elementary Differential Equations (MATH 224)**  3
Year Total:  19  16

### Third Year

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>Humanities or Social Science**</td>
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<tr>
<td><strong>Civil Engineering Materials (ECIV 211)</strong>*</td>
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<tr>
<td>Structural Analysis I (ECIV 320)</td>
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<tr>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**</td>
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<tr>
<td>Professional Communication for Engineers (ENGR 398)**</td>
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<td>Professional Communication for Engineers (ENGL 398)**</td>
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<tr>
<td>Structural Design I (ECIV 322)</td>
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<td>Engineering Hydraulics and Hydrology (ECIV 351)</td>
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### Fourth Year

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<tr>
<th>Units</th>
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<tbody>
<tr>
<td>Humanities or Social Science**</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Construction Management (ECIV 340)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Civil Engineering Senior Project (ECIV 398)</td>
<td>3</td>
<td></td>
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<tr>
<td>Approved elective(b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Approved elective(b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Humanities or Social Science**</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Civil Engineering Systems (ECIV 360)</td>
<td>3</td>
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<tr>
<td>Approved Natural Science Elective(c)</td>
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<tr>
<td>Approved elective(b,c)</td>
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<td></td>
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<tr>
<td>Open elective</td>
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<tr>
<td>Year Total:</td>
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<td>15</td>
</tr>
</tbody>
</table>

Total Units in Sequence:  130

* University general education requirement
** Engineering general education requirement
\(a\) ENGR 398 and ENGL 398 must be taken concurrently.
\(b\) Must be part of an approved sequence
\(c\) Must be an approved course in a traditional science other than chemistry or physics such as biology, astronomy, or geology.

---

### Co-op and Internship Programs (http://engineering.case.edu/coop)

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

### BS/MS Program

The Department also encourages CWRU undergraduate students to make use of the university's BS/MS program to pursue advanced studies in Civil Engineering. Undergraduates should apply for the BS/MS program in their junior year so they are able to select senior electives that will also satisfy MS degree requirements. Up to 9 hours of senior electives may be counted in both the BS and MS program thus allowing the student to complete the MS degree in the fifth year of study. Fifth year tuition scholarships may also be available. For more information students should discuss the BS/MS program with their Academic Adviser and/or the department BS/MS program coordinator. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

### Minor in Civil Engineering

Students enrolled in other majors may elect to pursue a minor in Civil Engineering requiring 15 credit hours. Course selections require the approval of a Civil Engineering minor advisor. Recommended course from the Department's areas of concentration are as follows:

#### Engineering Mechanics

- ECIV 160 Surveying and Computer Graphics
- ECIV 211 Civil Engineering Materials
- ECIV 310 Strength of Materials
- ECIV 360 Civil Engineering Systems
- ECIV 411 Elasticity, Theory and Applications
- ECIV 420 Finite Element Analysis

#### Structural Engineering

- ECIV 160 Surveying and Computer Graphics
- ECIV 211 Civil Engineering Materials
- ECIV 310 Strength of Materials
- ECIV 330 Soil Mechanics
- ECIV 360 Civil Engineering Systems
- ECIV 430 Foundation Engineering
- ECIV 433 Soil Dynamics
- ECIV 437 Pavement Analysis and Design

#### Geotechnical Engineering

- ECIV 160 Surveying and Computer Graphics
- ECIV 211 Civil Engineering Materials
- ECIV 310 Strength of Materials
- ECIV 330 Soil Mechanics
- ECIV 360 Civil Engineering Systems
- ECIV 430 Foundation Engineering
- ECIV 433 Soil Dynamics
- ECIV 437 Pavement Analysis and Design

#### Construction Engineering and Management

- ECIV 160 Surveying and Computer Graphics
- ECIV 211 Civil Engineering Materials
- ECIV 340 Construction Management
Environmental Engineering

ECIV 360   Civil Engineering Systems

ECIV 160   Surveying and Computer Graphics

ECIV 211   Civil Engineering Materials

ECIV 351   Engineering Hydraulics and Hydrology

ECIV 361   Water Resources Engineering

ECIV 362   Solid and Hazardous Waste Management

ECIV 368   Environmental Engineering

ECIV 460   Environmental Remediation

* Approval of the department is required.

Graduate Programs

The MS and PhD programs in structural engineering, geotechnical engineering, engineering mechanics and environmental engineering prepare students for careers in industry, professional practice, research and teaching. Experience has shown that job opportunities are excellent for students who receive advanced degrees in Civil Engineering from Case Western Reserve University. Recent advanced degree recipients have found positions in universities, consulting firms, state and federal agencies, aerospace firms, and the energy industry.

Each student’s program of course work and research is tailored to his or her interests, in close consultation with a faculty advisor. For students working toward the Master of Science degree, study plans may include a research oriented thesis,a practice oriented project, or courses only followed by a comprehensive exam. For students working toward the Doctor of Philosophy degree a research dissertation is required.

Civil Engineering graduate students are also encouraged to review the CWRU School of Graduate Studies web page for additional details about University requirements for advanced degree programs.

Review the School of Graduate Studies MS and PhD degree requirements here (p. 1045).

A Master of Science in Civil Engineering degree is also available exclusively online. Visit http://online-engineering.case.edu/civil/ for more details.

Facilities

Vanderhoof-Schuette Structural Laboratory

The Vanderhoof-Schuette Structural Laboratory and Educational facility features a 2400 ft² cellular strong floor and a 28 ft. high, L-shaped cellular strong wall. The strong wall includes a vertical cell for testing tall specimens with loads up to 1000kips. A 15-ton crane, a scissors lift, and a forklift truck are available for positioning specimens. A 95 gpm hydraulic pump powers servo-hydraulic actuators for applying static or dynamic forces. The laboratory has a variety of instrumentation and data acquisition equipment. Four 6 ft x 6 ft uni-axial shaking tables are available for seismic testing of small physical models.

Environmental Engineering Laboratory

This laboratory is one in a suite of laboratories that support Environmental Engineering teaching and research. The facilities include a teaching laboratory, an advanced instrumentation laboratory, a remediation research laboratory and an electronic classroom/software laboratory. The Environmental Engineering laboratory is equipped for conventional Standard Methods analysis of water, wastewater, soil, solid waste, and air samples (pH meters, furnaces, ovens, incubators, hoods, etc.) and for aerobic microbiology work. The lab also offers generous bench top space for student teams to explore laboratory procedures and provides direct access to research, instrumentation, and computational facilities.

Environmental Biotechnology Laboratory

This laboratory is equipped for culturing, processing, and analyzing microorganisms for remediation and biofuel research. Algae are cultivated in a Conviron A1000 growth chamber with programmable temperature and light controls. A Labcomp laminar-flow biocabinet and a Uamato autoclave are used for microbial culturing. Two refrigerated centrifuges, including a microcentrifuge, are available for culture separation. The laboratory is also equipped for molecular analyses with a thermal cycler and regulated temperature baths, with a New Brunswick incubated orbital shaker, a New Brunswick ultra-low temperature freezer and a Panasonic microwave oven.

Geotechnical Engineering Laboratories

The new state of the art Geotechnical Engineering Laboratories and Educational Facilities offer an ideal environment for teaching and research:

The Frank Gerace Undergraduate Laboratory has a complete array of modern units for characterizing and testing soils. Such units lend themselves to automated data acquisition and processing.

The Richard A. Saada Intelligent Geosystems Laboratory houses innovative interdisciplinary research including sensor and non-destructive technologies such as Time Domain Reflectometry (TDR), ultrasonics, optic sensors, smart and functional materials, multiphysics processes in porous materials, etc.

The Saada Family Geotechnical Laboratory has a full array of strength and deformation testing units; notable are automated triaxial units for generalized extension and compression tests, units permitting simultaneous application of hydrostatic, axial and torsional static and dynamic loads, units by means of which one dimensional consolidation in the triaxial cell can be achieved, and various pore pressure, force and deformation measuring devices. Also available is a longitudinal and torsional resonant column device and a large size oedometer equipped with bender elements.

A 20g-tons fully automated centrifuge with a servo hydraulic earthquake shaker is in operation.

The Warren C. Gibson library has a large array of reference materials, conference proceedings and internet connection to the University library and other sources of technical information.

Haptic Research Laboratory

The haptic interface laboratory hosts two state-of-the-art driving simulators. It provides holistic driving simulations for advanced research, education and training in the area of transportation safety, human perception and human-machine interface.

Neff Civil Engineering Undergraduate Computer Laboratory

This laboratory provides Civil Engineering students with access to all the computer resources needed for both course work and research. The
laboratory is supplemented by other facilities provided by the university. All of the computers in the Neff lab can act as independent workstations or provide access via a fiber optic link to other campus computers.

**Civil Engineering Study Lounge**
This study area is designed to supplement the computer laboratories with a quiet workplace for individual or group study.

**ASCE Lounge**
Provides a student controlled venue for hosting American Society of Civil Engineers (ASCE) student chapter activities.

**Miller Library**
The Miller Library named in honor of Graig J. Miller, a former Civil Engineering faculty member, acts as both a library and as the Department’s premier meeting space.

**Vose Room**
The department also shares use of the Vose Room equipment for meetings and video conferencing.

**Emeritus Faculty**
J. Ludwig Figueroa, PhD
(University of Illinois)
*Professor Emeritus*

Dario A. Gasparini, PhD
(Massachusetts Institute of Technology)
*Professor Emeritus*

Arthur A. Huckelbridge, DEng, PE
(University of California Berkeley)
*Professor Emeritus*

**Faculty**
Xiangwu (David) Zeng, PhD, PE
(Cambridge University)
*Chair and Frank H. Neff Professor*
Geotechnical earthquake engineering; centrifuge modeling; foundation vibration

YeongAe Heo, PhD
(University of California, Davis)
*Assistant Professor*
Multi-scale numerical modeling and simulation for nonlinear dynamic behavior of structural materials and systems; Multi-hazard and risk engineering; risk-based extreme dynamic load resistant design for onshore and offshore structures and infrastructures; big data analysis application to structural engineering

Yue Li, PhD
(Georgia Institute of Technology)
*Associate Professor*
Probabilistic analysis, structural and systems reliability, multi-hazard assessment and mitigation, risk-informed decision making, resilient and sustainability civil infrastructure systems, earthquake engineering, wind engineering, impact of climate change and adaptation strategies.

Michael Pollino, PhD, SE, PE
(University at Buffalo)
*Assistant Professor*
Structural engineering; seismic analysis and design, rehabilitation of structures and civil infrastructure, large scale experimental testing of structural systems and sub-assemblies, structural dynamics, steel structures

Kurt. R. Rhoads, PhD, PE
(Stanford University)
*Assistant Professor*
Environmental Engineering; Fate of organic pollutants, bioremediation, algal biofuel development

Adel S. Saada, PhD, PE
(Princeton University)
*Professor*
Mechanics of materials; static and dynamic mechanical behavior of soils; foundation engineering

Katie P. Wheaton, M.S., P.E., S.E.
(Lehigh University)
*Instructor*
Structural engineering; steel, concrete, and wood structures; geomatics; CAD modeling.

Xiong (Bill) Yu, PhD, PE
(Purdue University)
*Associate Professor*
Geotechnical engineering; infrastructure; construction material testing; information technology; intelligent infrastructure; energy geotechnology; sustainable design; sensors: structural health monitoring

**Adjunct Faculty**
Terrance Cybulski, Adjunct Lecturer

Philip DeSantis, Adjunct Professor

Dan Ghiocel, Adjunct Professor

Mark D. Rokoff, Adjunct Assistant Professor

Lance Wanamaker, Adjunct Lecturer

Erwin V. Zaretsky, Adjunct Professor

**Staff**
Nancy A. Longo
*Department Chair Assistant*

Michael Butler
*Department Engineer*

**Courses**
ECIV 160. Surveying and Computer Graphics. 3 Units.
Principles and practice of surveying; error analysis, topographic mapping, introduction to photogrammetry and GIS; principles of graphics; computer-aided-drafting. Laboratory.
ECIV 211. Civil Engineering Materials. 3 Units.

ECIV 300. Undergraduate Research. 3 Units.
Research conducted under the supervision of a sponsoring Civil Engineering faculty member. Research can be done on an independent topic or as part of an established on-going research activity. The student will prepare a written report on the results of the research. Course may fulfill one technical elective requirement.

ECIV 310. Strength of Materials. 3 Units.

ECIV 320. Structural Analysis I. 3 Units.

ECIV 321. Matrix Analysis of Structures. 3 Units.
Matrix formulation and computer analysis (MATLAB recommended) for statically indeterminate linear structural systems; Stiffness method (direct/displacement method); Potential Energy Method; Development of element equations for 1D axial and flexural members and 2D triangle element; Transformation between local to global coordinates; Development of displacement fields (linear function for axial members and cubic function for flexural members); Shape function concept in approximation; Introduction to elasticity, finite element analysis and nonlinear structural analysis. Recommended preparation: Linear Algebra. Prereq: ECIV 320 and EMAE 250.

ECIV 322. Structural Design I. 3 Units.

ECIV 323. Structural Design II. 3 Units.

ECIV 324. Timber and Masonry Design. 3 Units.
Introduction to wood material. Design for timber beams and columns to resist vertical and lateral loads. Design of nailed and bolted connections. Introduction to masonry materials and design of wall. Prereq: ECIV 320.

ECIV 330. Soil Mechanics. 4 Units.
The physical, chemical, and mechanical properties of soils. Soil classification, capillarity, permeability, and flow nets. One dimensional consolidation, stress and settlement analysis. Shear strength, stability of cuts, and design of embankments, retaining walls and footings. Standard laboratory tests performed for the determination of the physical and mechanical properties of soils. Laboratory. Recommended preparation: ECIV 310.

ECIV 340. Construction Management. 3 Units.
Selected topics in construction management including specifications writing, contract documents, estimating, materials and labor, bidding procedures and scheduling techniques. The course is augmented by guest lecturers from local industries.

ECIV 341. Construction Scheduling and Estimating. 3 Units.
The focus is on scheduling, and estimating and bidding for public and private projects. This includes highways as well as industrial and building construction. The use of computers with the latest software in estimating materials, labor, equipment, overhead and profit is emphasized. Recommended preparation: ECIV 340 and consent of instructor.

ECIV 351. Engineering Hydraulics and Hydrology. 3 Units.
Application of fluid statics and dynamics to Civil Engineering Design. Hydraulic machinery, pipe network analysis, thrust, hammer, open channel flow, sewer system design, culverts, flow gauging, retention/detention basin design. Applied hydrology, hydrograph analysis and hydraulic routing will also be introduced. Recommended preparation: Concurrent enrollment in ENGR 225.

ECIV 360. Civil Engineering Systems. 3 Units.
Introduction to probability and statistics. Discrete and continuous random variables, probability distributions, bivariate data, probabilistic analysis of systems, and reliability analysis. Introduction to engineering economics. Interest rates and equivalence, present worth, rate of return analysis, depreciation, and inflation.

ECIV 361. Water Resources Engineering. 3 Units.
Water doctrine, probabilistic analysis of hydrologic data, common and rare event analysis, flood forecasting and control, reservoir design, hydrologic routing, synthetic streamflow generation, hydroelectric power, water resource quality, water resources planning. Recommended preparation: ECIV 351.

ECIV 362. Solid and Hazardous Waste Management. 3 Units.

ECIV 366. Environmental Engineering. 3 Units.
Principle and practice of environmental engineering. Water and waste water engineering unit operations and processes including related topics from industrial waste disposal, air pollution and environmental health.

ECIV 396. Civil Engineering Special Topics I. 1 - 3 Units.
Special topics in civil engineering in which a regular course is not available. Conferences and report.

ECIV 397. Civil Engineering Topics II. 3 Units.
Special topics in civil engineering in which a regular course is not available. Conferences and report.

ECIV 398. Civil Engineering Senior Project. 3 Units.
A project emphasizing research and/or design must be completed by all civil engineers. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Counts as SAGES Senior Capstone.
ECIV 400T. Graduate Teaching I. 0 Unit.
This series of three courses will provide Ph.D. students with practical experience in teaching at the University level and will expose them to effective teaching methods. Each course assignment will be organized in coordination with the student’s dissertation advisor and the department chairperson. Assignments will successively require more contact with students, with duties approaching the teaching requirements of a faculty member in the Ph.D. student’s area of study. Prereq: Ph.D. students in Civil Engineering.

ECIV 411. Elasticity, Theory and Applications. 3 Units.

ECIV 420. Finite Element Analysis. 3 Units.
Theory and application of the finite element method. Approximation theory as the basis for finite element methods. The formulations for a variety of finite elements in one, two, and three dimensions. The modeling and analysis of structural components and systems using planar, solid, and plate elements. Implementations of element formulations using Matlab. An advanced finite element analysis program will be used for analysis of structural problems. Recommended preparation: ECIV 321 is a prerequisite for structural engineering students. Background in advanced mechanics and numerical analysis of structures is required for this course. If you have not completed these courses, please discuss with the instructor. Prereq: Graduate Standing or ECIV 321.

ECIV 421. Advanced Topics in Reinforced Concrete Structures. 3 Units.
Group project-based course to design and evaluate multistory reinforced concrete structures according to the US building design codes (ACI318, ASCE7, ASCE41), including inelastic behavior of plain concrete, reinforced concrete, and reinforcing steel; inelastic rebar buckling and slip behavior; reinforcement design under various loads; design evaluation criteria at member level and system level; nonlinear static structural analysis method (Pushover analysis) for RC frames under dynamic lateral forces using an open source code (OpenSees). Prereq: Graduate Standing or ECIV 321, ECIV 322 and ECIV 323.

ECIV 422. Advanced Structural Steel Design. 3 Units.
Selected topics in structural steel design including plastic design, torsion, lateral buckling, torsional-flexural buckling, frame stability, plate girders, and connections, including critical review of current design specifications relating to these topics. Recommended preparation: ECIV 322.

ECIV 423. Prestressed Concrete Design. 3 Units.
Design of prestressed concrete structures, mechanical behavior of concrete suitable for prestressing and prestressing steels, load balancing, partial prestressing, prestressing losses, continuous beams, prestressed slab design, columns. Recommended preparation: ECIV 323 or ECIV 421 and consent of instructor.

ECIV 424. Structural Dynamics. 3 Units.
Modeling of structures as single and multidegree of freedom dynamic systems. The eigenvalue problem, damping, and the behavior of dynamic systems. Deterministic models of dynamic loads such as wind and earthquakes. Analytical methods, including modal, response spectrum, time history, and frequency domain analyses. Recommended preparation: ECIV 321 and consent of instructor.

ECIV 425. Structural Design for Dynamic Loads. 3 Units.
Structural design problems in which dynamic excitations are of importance. Earthquake, wind, blast, traffic, and machinery excitations. Human sensitivity to vibration, mechanical behavior of structural elements under dynamic excitation, earthquake response and earthquake-resistant design, wind loading, damping in structures, hysteretic energy dissipation, and ductility requirements. Recommended preparation: ECIV 424.

ECIV 426. Probabilistic Analysis. 3 Units.

ECIV 430. Foundation Engineering. 3 Units.

ECIV 431. Special Topics in Geotechnical Engineering. 3 Units.

ECIV 432. Mechanical Behavior of Soils. 3 Units.
Soil statics and stresses in a half space-tridimensional consolidation and sand drain theory; stress-strain relations and representations with rheological models. Critical state and various failure theories and their experimental justification for cohesive and noncohesive soils. Laboratory measurement of rheological properties, pore water pressures, and strength under combined stresses. Laboratory. Recommended preparation: ECIV 330.

ECIV 433. Soil Dynamics. 3 Units.

ECIV 434. Field Instrumentation and In situ Testing. 3 Units.

ECIV 437. Pavement Analysis and Design. 3 Units.
ECIV 450. Environmental Engineering Chemistry. 3 Units.
Fundamentals of inorganic, organic, and physical chemistry with emphasis on the types of problems encountered in the environmental engineering field. Equilibria among liquid, gaseous, and solid phases; kinetics to the extent that time permits. A strong mathematical approach is taken in solving the equilibrium and kinetic problems presented. Equilibrium speciation software for solution of more complex problems. Topics that will be covered in the course include chemical equilibrium, acid/base reactions, mathematical problem solving approach, graphical approaches, titration curves, solubility of gases and solids, buffering systems, numerical solution of equilibrium problems, thermodynamics, oxidation-reduction reactions, principles of quantitative chemistry and analytical techniques, introduction to the use of analytical instrumentation, and chemical kinetics. Prereq: ECIV 368 or requisites not met permission.

ECIV 456. Intelligent Infrastructure Systems. 3 Units.
Topics on smart infrastructure systems; smart materials fabrication, embedded sensing technology for infrastructure condition monitoring, the system models for infrastructural condition diagnosing and adaptive controlling, and spatial-temporal integrated infrastructure management system.

ECIV 460. Environmental Remediation. 3 Units.
Evolution of proactive environmental engineering to recover contaminated air, water, and soil environments. Lake and river remediation, contaminated sediments, indoor air quality, chemical spills, underground storage tanks, contaminated soils, solid and hazardous waste sites, superfund remediation. Recommended preparation: ECIV 368 or consent of instructor.

ECIV 461. Environmental Engineering Biotechnology. 3 Units.
Process design fundamentals for biological reactors applied to environmental engineering processes, including wastewater treatment, bioremediation, and bioenergy production. Topics include mass balances, methane fermentation, fixed-growth reactors, molecular biology tools, and reactor models. Recommended preparation: ECIV 368 Environmental Engineering.

ECIV 500T. Graduate Teaching II. 0 Unit.
This series of three courses will provide Ph.D. students with practical experience in teaching at the University level and will expose them to effective teaching methods. Each course assignment will be organized in coordination with the student’s dissertation advisor and the department chairperson. Assignments will successively require more contact with students, with duties approaching the teaching requirements of a faculty member in the Ph.D. student’s area of study. Prereq: Ph.D. students in Civil Engineering.

ECIV 500T. Graduate Teaching III. 0 Unit.
This series of three courses will provide Ph.D. students with practical experience in teaching at the University level and will expose them to effective teaching methods. Each course assignment will be organized in coordination with the student’s dissertation advisor and the department chairperson. Assignments will successively require more contact with students, with duties approaching the teaching requirements of a faculty member in the Ph.D. student’s area of study. Prereq: Ph.D. students in Civil Engineering.

ECIV 501. Dissertation Ph.D.. 1 - 9 Units.
Plan A.
ECIV 651. Thesis M.S.. 1 - 18 Units.
Plan B.

ECIV 660. Special Topics. 1 - 18 Units.
Topics of special interest to students and faculty. Topics can be those covered in a regular course when the student cannot wait for the course to be offered.

ECIV 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Electrical Engineering and Computer Science

Glennan Building (7071)
http://engineering.case.edu/eecs/
Phone: 216.368.2800; Fax: 216.368.6888
PhD, Professor and Chair

Electrical Engineering and Computer Science (EECS) spans a spectrum of topics from (i) materials, devices, circuits, and processors through (ii) control, signal processing, and systems analysis to (iii) software, computation, computer systems, and networking. At the graduate level, the department offers the Master of Science and Doctor of Philosophy degrees in Electrical Engineering, Computer Engineering, Systems & Control Engineering, and Computer Science. Each degree program leads to the Bachelor of Science degree at the undergraduate level. At the graduate level, the department offers the Master of Science and Doctor of Philosophy degrees in Electrical Engineering, Computer Engineering, Systems & Control Engineering, and Computing & Information Sciences (i.e., computer science). We offer minors in Electrical Engineering, Computer Science (BS and BA), Computer Engineering, Systems & Control Engineering, and Computer Gaming, Artificial Intelligence (AI), and Electronics. Additionally, a minor in Applied Data Science is administered by the Department of Materials Science and Engineering. For supplemental information to this bulletin as well as the latest updates, please visit the EECS Department web site at http://eecs.case.edu.

EECS is at the heart of modern technology. EECS disciplines are responsible for the devices and microprocessors powering our computers and embedded into everyday devices, from cell phones and tablets to automobiles and airplanes. Healthcare is increasingly building on EECS technologies: micro/nano systems, electronics/instrumentation, implantable systems, wireless medical devices, surgical robots, imaging, medical informatics, bioinformatics, system biology, and data mining and visualization. The future of energy will be profoundly impacted by EECS technologies, from smart appliances connected to the Internet,
The EECS department includes departments in Computer Science, Electrical, Computer, and Systems Engineering. EECS at Case Western Reserve is organized internally into two informal divisions: (i) Computer Science (CS); and (ii) Electrical, Computer, and Systems Engineering (ECSE).

**Educational Philosophy**

The EECS department is dedicated to developing high-quality graduates who will take positions of leadership as their careers advance. We recognize that the increasing role of technology in virtually every facet of our society, life, and culture makes it vital that our students have access to progressive and cutting-edge higher education programs. The program values for all of the degree programs in the department are:

- mastery of fundamentals
- creativity
- social awareness
- leadership skills
- professionalism

Stressing excellence in these core values helps to ensure that our graduates are valued and contributing members of our global society and that they will carry on the tradition of engineering leadership established by our alumni.

Our goal is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies which will advance their fields. To achieve this goal, the department offers a wide range of technical specialties consistent with the breadth of electrical engineering and computer science, including recent developments in the field. Because of the rapid pace of advancement in these fields, our degree programs emphasize a broad and foundational science and technology background that equips students for future developments. Our programs include a wide range of electives and our students are encouraged to develop individualized programs which can combine many aspects of electrical engineering and computer science.

**Research**

The research thrusts of the Electrical Engineering and Computer Science department include:

1. Micro/Nano Systems
2. Electronics and Instrumentation
3. Robotics and Haptics
4. Embedded Systems, including VLSI, FPGA
6. Bioinformatics and Systems Biology
7. Machine Learning and Data Mining
8. Computer Networks and Distributed Systems
9. Secure and Reliable Software
10. Energy Systems, including Wind and Power Grid Management/Control
11. Gaming, Simulation, Optimization
12. Medical Informatics and Wireless Health

EECS participates in a number of groundbreaking collaborative research and educational programs, including the Microelectromechanical Systems Research Program, the Center for Computational Genomics, graduate program in Systems Biology and Bioinformatics, the Clinical & Translational Science Collaborative, the Great Lakes Energy Institute, and the VA Center for Advanced Platform Technology.

**Undergraduate Programs**

The EECS department offers programs leading to degrees in:

1. Data Science and Analytics (B.S.)
2. Electrical Engineering (B.S.)
3. Systems and Control Engineering (B.S.)
4. Computer Engineering (B.S.)
5. Computer Science (B.S., B.A.)

These programs provide students with a strong background in the fundamentals of mathematics, science, and engineering. Students can use their technical and open electives to pursue concentrations in bioelectrical engineering, complex systems, automation and control, digital systems design, embedded systems, micro/nano systems, robotics and intelligent systems, signal processing and communications, and software engineering. In addition to an excellent technical education, all students in the department are exposed to societal issues, ethics, professionalism, and have the opportunity to develop leadership and creativity skills.

The Bachelor of Science degree programs in Computer Engineering, Electrical Engineering, and Systems and Control Engineering are accredited by the Engineering Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

The Bachelor of Science degree program in Computer Science is accredited by the Computing Accreditation Commission of ABET, [www.abet.org](http://www.abet.org).

The Bachelor of Science program in data science and analytics provides our students with a broad foundation in the field and the instruction, skills, and experience needed to understand and handle large amounts of data that transform thinking about a collection of vast amounts of data into one that focuses on the data's conversion to actionable information. The degree program has a unique focus on real-world data and real-world applications.

This major is one of the first undergraduate programs nationwide with a unique curriculum that includes mathematical modeling, informatics, data analytics, visual analytics and project-based applications - all elements of the future emerging field of data science.

An undergraduate minor in Applied Data Science (p. 129) is administered in the Materials Science and Engineering Department.
Bachelor of Science in Data Science and Analytics

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

**Major Requirements**

- CHEM 111 Principles of Chemistry for Engineers 4
- DSCI 133 Introduction to Data Science and Engineering for Majors 3
- DSCI 234 Structured and Unstructured Data 3
- DSCI 341 Introduction to Databases: DS Major 3
- DSCI 342 Introduction to Data Science Systems 3
- DSCI 343 Introduction to Data Analysis 3
- DSCI 344 Scalable Parallel Data Analysis 3
- DSCI 345 Files, Indexes and Access Structures for Big Data 3
- EECS 132 Introduction to Programming in Java 3
- EECS 302 Discrete Mathematics 3
- EECS 340 Algorithms 3
- EECS 393 Software Engineering 3
- ENGL 398 Professional Communication for Engineers 2
- ENGR 398 Professional Communication for Engineers 1
- MATH 201 Introduction to Linear Algebra for Applications 3
- MATH 121 Calculus for Science and Engineering I 4
- MATH 122 Calculus for Science and Engineering II 4
- MATH 223 Calculus for Science and Engineering III 3
- MATH 224 Elementary Differential Equations 3
- PHYS 121 General Physics I - Mechanics 4
- PHYS 122 General Physics II - Electricity and Magnetism 4

Core courses provide our students with a strong background in signal processing, systems, and analytics. Students are required to develop depth in at least one of the following technical areas: signal processing, systems, and analytics. Each data science and analytics student must complete the major requirements:

**Technical Elective Requirement**

Each student must complete 8 courses (24 credit-hours) of approved technical electives. Technical electives shall be chosen to fulfill the probability/statistics elective (1 course), the computer and data security elective (1 course), the depth requirement (3 courses), and 3 courses otherwise chosen to increase the student’s understanding of data science and analytics. Technical electives not used to satisfy the probability/statistics elective, the computer and data security elective, or the depth requirement are more generally defined as any course related to the principles and practice of data science and analytics. This includes all DSCI courses at the 200 level and above and can include courses from other programs. All non-DSCI technical electives must be approved by the student’s academic advisor.

**Depth Requirement**

Each student must show a depth of competence in one technical area by taking at least three courses from one of the following three areas. Additional courses, beyond those that are listed, may be approved by the student’s academic advisor.

- **Area I: Signal Processing**
  - Eecs 246 Signals and Systems 4
  - Eecs 313 Signal Processing 3
  - Stat 332 Statistics for Signal Processing 3

- **Area II: Systems**
  - Eecs 325 Computer Networks I 3
  - Eecs 425 Computer Networks I 3
  - Eecs 338 Intro to Operating Systems and Concurrent Programming 4
  - Eecs 600 Special Topics (Cloud Computing) 1 - 18

- **Area III: Analytics**
  - Dsci 390 Machine Learning for Big Data 3
  - Dsci 391 Data Mining for Big Data 3
  - Eecs 339 Web Data Mining 3
  - Eecs 346 Engineering Optimization 3
  - Eecs 440 Machine Learning 3
  - Eecs 442 Causal Learning from Data 3

**Computer and Data Security Elective Requirement**

- Eecs 444 Computer Security 3
- MATH 408 Introduction to Cryptology 3

**Statistics Requirement**

- MATH 380 Introduction to Probability 3
- Stat 325 Data Analysis and Linear Models 3

**Design Requirement**

- Dsci 398 Engineering Projects I
- Dsci 399 Engineering Projects II

**Suggested Program of Study: Bachelor of Science in Data Science and Analytics**

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

<table>
<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>SAGES First Year Seminar*</td>
<td>4</td>
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<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)</td>
<td>4</td>
<td></td>
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<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Introduction to Programming in Java (EECS 132)</td>
<td>3</td>
<td></td>
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<tr>
<td>PHED (2 half semester courses)*</td>
<td>0</td>
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<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
General Physics I - Mechanics (PHYS 121) 4
Calculus for Science and Engineering II (MATH 122) 4
Introduction to Data Science and Engineering for Majors (DSCI 133) 3
PHED (2 half semester courses)* 0
Open Elective 3
Year Total: 15 17

Open elective 3
Year Total: 16 16
Total Units in Sequence: 125

* University general education requirement
a Probability and statistics elective (MATH 380, STAT 325)
b Computer and data security elective (EECS 444, MATH 408)
c Technical electives in signal processing, systems, and analytics (see lists of approved courses under program requirements)
d Technical electives

Minor in Data Science
An undergraduate minor in applied data science (p. 129) is administered in the Materials Science and Engineering Department.

Bachelor of Science in Electrical Engineering
The Bachelor of Science program in electrical engineering provides our students with a broad foundation in electrical engineering through combined classroom and laboratory work, and prepares our students for entering the profession of electrical engineering, as well as for further study at the graduate level.

Mission
The educational mission of the electrical engineering program is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies that will advance the general field of electrical engineering.

Program Educational Objectives
1. Graduates will be successful professionals obtaining positions appropriate to their background, interests, and education.
2. Graduates will use continuous learning opportunities to improve and enhance their professional skills.
3. Graduates will demonstrate leadership in their profession.

Student Outcomes
As preparation for achieving the above educational objectives, the BS degree program in Electrical Engineering is designed so that students attain:

• an ability to apply knowledge of mathematics, science, and engineering
• an ability to design and conduct experiments, as well as to analyze and interpret data
• an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
• an ability to function on multi-disciplinary teams
• an ability to identify, formulate, and solve engineering problems
• an understanding of professional and ethical responsibility
• an ability to communicate effectively
• the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
• a recognition of the need for, and an ability to engage in life-long learning
• a knowledge of contemporary issues
• an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Core courses provide our students with a strong background in signals and systems, computers, electronics (both analog and digital), and semiconductor devices. Students are required to develop depth in at least one of the following technical areas: signals and systems, solid state, computer hardware, computer software, control, circuits, robotics, and biomedical applications. Each electrical engineering student must complete the following requirements.

## Major in Electrical Engineering

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

### Major Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 245</td>
<td>Electronic Circuits</td>
<td>4</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 309</td>
<td>Electromagnetic Fields I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 313</td>
<td>Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EECS 321</td>
<td>Semiconductor Electronic Devices</td>
<td>4</td>
</tr>
</tbody>
</table>

Core courses provide our students with a strong background in signals and systems, computers, electronics (both analog and digital), and semiconductor devices. Students are required to develop depth in at least one of the following technical areas: signals and systems, solid state, computer hardware, computer software, control, circuits, robotics, and biomedical applications. Each electrical engineering student must complete the following requirements:

### Technical Elective Requirement

Each student must complete eighteen (18) credit-hours of approved technical electives. Technical electives shall be chosen to fulfill the depth requirement (see next) and otherwise increase the student’s understanding of electrical engineering. Technical electives not used to satisfy the depth requirement are more generally defined as any course related to the principles and practice of electrical engineering. This includes all EECS courses at the 200 level and above and can include courses from other programs. All non-EECS technical electives must be approved by the student’s academic advisor.

### Depth Requirement

Each student must show a depth of competence in one technical area by taking at least three courses from one of the following eight areas. This depth requirement may be met using a combination of the above core courses and a selection of open and technical electives.

#### Area I: Signals & Systems

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 313</td>
<td>Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EECS 351</td>
<td>Communications and Signal Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 354</td>
<td>Digital Communications</td>
<td>3</td>
</tr>
<tr>
<td>EECS 490</td>
<td>Digital Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>MATH 307</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Area II: Computer Software

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 293</td>
<td>Software Craftsmanship</td>
<td>4</td>
</tr>
<tr>
<td>EECS 302</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 338</td>
<td>Intro to Operating Systems and Concurrent Programming</td>
<td>4</td>
</tr>
<tr>
<td>EECS 340</td>
<td>Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>EECS 373</td>
<td>Modern Robot Programming (Fall 2017)</td>
<td>4</td>
</tr>
<tr>
<td>EECS 391</td>
<td>Introduction to Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>EECS 393</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Area III: Solid State

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 321</td>
<td>Semiconductor Electronic Devices</td>
<td>4</td>
</tr>
<tr>
<td>EECS 322/415</td>
<td>Integrated Circuits and Electronic Devices</td>
<td>3</td>
</tr>
<tr>
<td>EECS 422</td>
<td>Solid State Electronics II</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Area IV: Control

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 304</td>
<td>Control Engineering I with Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>EECS 346</td>
<td>Engineering Optimization</td>
<td>3</td>
</tr>
<tr>
<td>EECS 374</td>
<td>Advanced Control and Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>EECS 375</td>
<td>Applied Control</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Area V: Circuits

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 245</td>
<td>Electronic Circuits</td>
<td>4</td>
</tr>
<tr>
<td>EBME 310</td>
<td>Principles of Biomedical Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>EECS 326</td>
<td>Instrumentation Electronics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 344</td>
<td>Electronic Analysis and Design</td>
<td>3</td>
</tr>
<tr>
<td>EECS 371</td>
<td>Applied Circuit Design</td>
<td>4</td>
</tr>
<tr>
<td>EECS 426</td>
<td>MOS Integrated Circuit Design</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Area VI: Computer Hardware

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 301</td>
<td>Digital Logic Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>EECS 314</td>
<td>Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>EECS 315</td>
<td>Digital Systems Design</td>
<td>4</td>
</tr>
<tr>
<td>EECS 316</td>
<td>Computer Design</td>
<td>3</td>
</tr>
<tr>
<td>EECS 318</td>
<td>VLSI/CAD</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Area VII: Biomedical Applications

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBME 201</td>
<td>Physiology-Biophysics I (and 2 of the following 4 courses)</td>
<td>3</td>
</tr>
<tr>
<td>EBME 310</td>
<td>Principles of Biomedical Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>EBME 320</td>
<td>Medical Imaging Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>EBME 327</td>
<td>Bioelectric Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EBME 401D</td>
<td>Biomedical Instrumentation and Signal Processing</td>
<td>3</td>
</tr>
</tbody>
</table>
**Area VIII: Robotics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 275</td>
<td>Fundamentals of Robotics</td>
<td>4</td>
</tr>
<tr>
<td>EECS 304</td>
<td>Control Engineering I with Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>EECS 373/473</td>
<td>Modern Robot Programming (Fall 2017)</td>
<td>4</td>
</tr>
<tr>
<td>EECS 376</td>
<td>Mobile Robotics</td>
<td>4</td>
</tr>
<tr>
<td>EECS 484</td>
<td>Computational Intelligence I: Basic Principles</td>
<td>3</td>
</tr>
<tr>
<td>EECS 489</td>
<td>Robotics I</td>
<td>3</td>
</tr>
</tbody>
</table>

**Statistics Requirement**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing *</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>* STAT 333 Uncertainty in Engineering and Science may be substituted with approval of advisor</td>
<td></td>
</tr>
</tbody>
</table>

**Design Requirement**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 398</td>
<td>Engineering Projects I</td>
<td>4</td>
</tr>
<tr>
<td>EECS 399</td>
<td>Engineering Projects II</td>
<td>3</td>
</tr>
</tbody>
</table>

In consultation with a faculty advisor, a student completes the program by selecting technical and open elective courses that provide in-depth training in one or more of a spectrum of specialties, such as, control, signal processing, electronics, integrated circuit design and fabrication, and robotics. With the approval of the advisor, a student may emphasize other specialties by selecting elective courses from other programs or departments.

Additionally, math and statistics classes are highly recommended as an integral part of the student’s technical electives to prepare for work in industry and government and for graduate school. The following math/statistics classes are recommended and would be accepted as approved technical electives:

- MATH 201 - Introduction to Linear Algebra
- MATH 330 - Introduction to Scientific Computing
- MATH 380 - Introduction to Probability
- STAT 412 - Statistics for Design in Engineering and Science

Other Math/Statistics may be used as technical electives with the approval of the student’s academic advisor.

Many courses have integral or associated laboratories in which students gain “hands-on” experience with electrical engineering principles and instrumentation. Students have ready access to the teaching laboratory facilities and are encouraged to use them during nonscheduled hours in addition to the regularly scheduled laboratory sessions. Opportunities also exist for undergraduate student participation in the wide spectrum of research projects being conducted in the department.

**Suggested Program of Study: Major in Electrical Engineering**

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>SAGES First Year Seminar*</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
<td>4</td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
<td>4</td>
</tr>
<tr>
<td>Elementary Computer Programming (ENGR 131)**</td>
<td>3</td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
</tr>
<tr>
<td>PHED (2 half semester courses)*</td>
<td>0</td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121)**</td>
<td>4</td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122)**</td>
<td>4</td>
</tr>
<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
<td>4</td>
</tr>
<tr>
<td>PHED (2 half semester courses)*</td>
<td>0</td>
</tr>
<tr>
<td>Year Total:</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)**,b</td>
<td>4</td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223)**</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)**</td>
<td>4</td>
</tr>
<tr>
<td>Logic Design and Computer Organization (EECS 281)</td>
<td>4</td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
</tr>
<tr>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**</td>
<td>4</td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224)**</td>
<td>3</td>
</tr>
<tr>
<td>Electronic Circuits (EECS 245)</td>
<td>4</td>
</tr>
<tr>
<td>Electromagnetic Fields I (EECS 309)</td>
<td>3</td>
</tr>
<tr>
<td>Year Total:</td>
<td>15</td>
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<tr>
<td></td>
<td>17</td>
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<table>
<thead>
<tr>
<th>Third Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>HM/SS elective**,a</td>
<td>3</td>
</tr>
<tr>
<td>Statics and Strength of Materials (ENGR 200)**</td>
<td>3</td>
</tr>
<tr>
<td>Signals and Systems (EECS 246)</td>
<td>4</td>
</tr>
<tr>
<td>Statistics for Signal Processing (STAT 332)**</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective**</td>
<td>3</td>
</tr>
<tr>
<td>HM/SS elective**,a</td>
<td>3</td>
</tr>
<tr>
<td>Semiconductor Electronic Devices (EECS 321)</td>
<td>4</td>
</tr>
<tr>
<td>Signal Processing (EECS 313)</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective**</td>
<td>3</td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGL 398)**</td>
<td>2</td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGR 398)**</td>
<td>1</td>
</tr>
<tr>
<td>Year Total:</td>
<td>16</td>
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<tr>
<td></td>
<td>16</td>
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</table>

<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>HM/SS elective**,a</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Projects I (EECS 398)</td>
<td>4</td>
</tr>
<tr>
<td>Approved technical elective**</td>
<td>3</td>
</tr>
</tbody>
</table>
Double Major: Systems and Control & Electrical Engineering

The department also offers a double major in Systems and Control and Electrical Engineering. Students pursuing the Bachelor of Science in Electrical Engineering can take the following courses as technical and open electives to earn a second major in Systems and Control engineering:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 216</td>
<td>Fundamental System Concepts (S&amp;E)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units for Double Major:</strong></td>
<td>15</td>
</tr>
</tbody>
</table>

**Total Units in Sequence:** 128

**Hours Required for Graduation:** 128

- University general education requirement
- Engineering general education requirement
- Humanities/Social Science course
- Selected students may be invited to take PHYS 123 Physics and Frontiers I - Mechanics and PHYS 124 Physics and Frontiers II - Electricity and Magnetism in place of PHYS 121 General Physics I - Mechanics and PHYS 122 General Physics II - Electricity and Magnetism.
- Students may replace STAT 332 Statistics for Signal Processing with STAT 333 Uncertainty in Engineering and Science if approved by their advisor.
- Technical electives will be chosen to fulfill the depth requirement and otherwise increase the student's understanding of electrical engineering. Courses used to satisfy the depth requirement must come from the department's list of depth areas and related courses. Technical electives not used to satisfy the depth requirement are more generally defined as any course related to the principles and practice of electrical engineering. This includes all EECS courses at the 200 level and above, and can include courses from other programs. All non-EECS technical electives must be approved by the student's advisor.
- B.S./M.S. students may double count EECS 651 M.S. Thesis to fulfill the EECS 399 requirement.
- CO-OP students may obtain design credit for EECS 399 if their co-op assignment included significant design responsibility; however, the student is still responsible for such course obligations as reports, presentations, and ethics assignments. Design credit and fulfillment of remaining course responsibilities are arranged through the course instructor.
- At least 10 of the 14 required Electrical Engineering courses (EECS 281, 245, 246, 309, 313, 321, 398, 399 and the six technical electives) in the Electrical Engineering B.S. program must be satisfied by courses in the EECS department.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 304</td>
<td>Control Engineering I with Laboratory (EE, Area IV: Control), and (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 305</td>
<td>Control Engineering I Laboratory (This is the additional 1 credit-hour course needed (S&amp;CE))</td>
<td>1</td>
</tr>
<tr>
<td>EECS 324</td>
<td>Modeling and Simulation of Continuous Dynamical Systems (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 342</td>
<td>Introduction to Global Issues (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 346</td>
<td>Engineering Optimization (EE, Area IV: Control), and (S&amp;CE): and (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 352</td>
<td>Engineering Economics and Decision Analysis (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 375</td>
<td>Applied Control (EE, Area IV: Control), and (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 201</td>
<td>Introduction to Linear Algebra for Applications (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>OPRE 432</td>
<td>Computer Simulation (S&amp;CE)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Cooperative Education Program (http://engineering.case.edu/coop) in Electrical Engineering**

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

**BS/MS Program in Electrical Engineering**

The department encourages highly motivated and qualified students to apply for admission to the five-year BS/MS Program in the junior year. This integrated program, which permits up to 9 credit hours of graduate level coursework to be counted towards both BS and MS degree requirements (including an option to substitute MS thesis work for EECS 399, the second senior project). It also offers the opportunity to complete both the Bachelor of Science in Engineering and Master of Science degrees within five years. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

**Minor in Electrical Engineering**

Students enrolled in degree programs in other engineering departments can have a minor specialization by completing the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 245</td>
<td>Electronic Circuits</td>
<td>4</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 309</td>
<td>Electromagnetic Fields I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units for Minor in Electrical Engineering:</strong></td>
<td>18</td>
</tr>
</tbody>
</table>
Minor in Electronics
The department also offers a minor in electronics for students in the College of Arts and Sciences. This program requires the completion of 31 credit hours, of which 10 credit hours may be used to satisfy portions of the students’ skills and distribution requirements. The following courses are required for the electronics minor:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 131</td>
<td>Elementary Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 210</td>
<td>Introduction to Circuits and Instrumentation</td>
<td>4</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
</tbody>
</table>

Total Units: 31

Bachelor of Science in Systems and Control Engineering
The Bachelor of Science program in systems and control engineering provides our students with the basic concepts, analytical tools, and engineering methods which are needed in analyzing and designing complex technological and non-technical systems. Problems relating to modeling, simulation, decision-making, control, and optimization are studied. Some examples of systems problems which are studied include: modeling and analysis of complex biological systems, computer control of industrial plants, developing world models for studying environmental policies, and optimal planning and management in large-scale systems.

In each case, the relationship and interaction among the various components of a given system must be modeled. This information is used to determine the best way of coordinating and regulating these individual contributions to achieve the overall goal of the system.

Mission
The mission of the Systems and Control Engineering program is to provide internationally recognized excellence for graduate and undergraduate education and research in systems analysis, design, and control. These theoretical and applied areas require cross-disciplinary tools and methods for their solution.

Program Educational Objectives
1. Graduates will have applied systems methodology to multi-disciplinary projects that include technical, social, environmental, political, and/or economic factors.
2. Graduates will use systems understanding, critical thinking and problem solving skills to analyze and design engineering systems or processes that respond to technical and societal needs as demonstrated by their measured professional accomplishments in industry, government and research.
3. Graduates will facilitate multidisciplinary projects that bring together practitioners of various engineering fields in an effective, professional, and ethical manner as demonstrated by their teamwork, leadership, communication, and management skills.

Student Outcomes
- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.


Major in Systems and Control Engineering
In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

Major Requirements
- EECS 216 Fundamental System Concepts 3
- EECS 246 Signals and Systems 4
- EECS 304 Control Engineering I with Laboratory 3
- EECS 305 Control Engineering I Laboratory 1
- EECS 313 Signal Processing 3
- EECS 324 Modeling and Simulation of Continuous Dynamical Systems 3
- EECS 342 Introduction to Global Issues 3
- EECS 346 Engineering Optimization 3
- EECS 352 Engineering Economics and Decision Analysis 3
- OGRE 432 Computer Simulation 3
- EECS 399 Engineering Projects II 3

Fifteen hours of approved technical electives including at least 9 hours of approved courses to constitute a depth of study.

Breadth Requirement
- MATH 201 Introduction to Linear Algebra for Applications 3
- STAT 332 Statistics for Signal Processing 3

...
Statistics Requirement
STAT 332 Statistics for Signal Processing * 3

Design Requirement
EECS 398 Engineering Projects I 4

Depth Requirement
Each student must show a depth of competence in one technical area by taking at least three courses from one of the three tracks/program concentration areas, namely energy systems, control systems and data analytics, listed below:

Track 1: Energy Systems
EECS 368 Power System Analysis I 3
EECS 369 Power System Analysis II 3
EECS 370 Smart Grid 3
EECS 374 Advanced Control and Energy Systems 3
EECS 375 Applied Control 3
EECS 281 Logic Design and Computer Organization 4

Track 2: Control Systems
EECS 375 Applied Control 3
EECS 374 Advanced Control and Energy Systems 3
EECS 281 Logic Design and Computer Organization 4

Track 3: Data Analytics
- DSCI 343 Introduction to Data Analysis
- "Core Tools" list:
  - EECS 339 Web Data Mining 3
  - STAT 325 Data Analysis and Linear Models 3
  - STAT 326 Multivariate Analysis and Data Mining 3
  - EECS 435 Data Mining 3
  - EECS 452 Random Signals 3
  - EECS 490 Digital Image Processing 3
  - OPRE 433 Foundations of Probability and Statistics 3
- "Application" lists:

Business/Manufacturing Analytics:
- EECS 350 Operations and Systems Design 3
- EECS 360 Manufacturing and Automated Systems 3
- BAFI 361 Applied Financial Analytics 3
- MKMR 310 Marketing Analytics 3
- OPMT 475 Supply Chain Logistics 3

Healthcare Analytics
- EECS 319 Applied Probability and Stochastic Processes for Biology 3
- EECS 365 Complex Systems Biology 3
- MATH 378 Computational Neuroscience 3
- EBME 410 Medical Imaging Fundamentals 3
- BIOL 304 Fitting Models to Data: Maximum Likelihood Methods and Model Selection 3

Suggested Program of Study: Major in Systems and Control Engineering
The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

First Year
<table>
<thead>
<tr>
<th>Units</th>
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<tr>
<td>SAGES First Year Seminar *</td>
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<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
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</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
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<td>Elementary Computer Programming (ENGR 131)**</td>
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<td>Open elective</td>
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<tr>
<td>PHED 101 (Physical Education) *</td>
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<td>Calculus for Science and Engineering II (MATH 122)**</td>
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Second Year
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<td>General Physics II - Electricity and Magnetism (PHYS 122)**,a</td>
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<td>Calculus for Science and Engineering III (MATH 223)**</td>
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<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)**</td>
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<tr>
<td>Statistics for Signal Processing (STAT 332)</td>
<td>3</td>
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<tr>
<td>SAGES University Seminar *</td>
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<tr>
<td>Fundamental System Concepts (EECS 216)</td>
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</table>
Elementary Differential Equations (MATH 224)** 3
Statics and Strength of Materials (ENGR 200)** 3
Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)** 4
Introduction to Linear Algebra for Applications (MATH 201) 3

Year Total: 17 16

**Total Units in Sequence: 129

<table>
<thead>
<tr>
<th>Third Year</th>
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<tr>
<td>Signals and Systems (EECS 246)</td>
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<tr>
<td>Modeling and Simulation of Continuous Dynamical Systems (EECS 324)</td>
<td>3</td>
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<tr>
<td>Introduction to Global Issues (EECS 342)</td>
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<tr>
<td>Approved technical electivec</td>
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<tr>
<td>HM/SS elective</td>
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<tr>
<td>Engineering Economics and Decision Analysis (EECS 352)</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Projects II with Laboratory (EECS 304)</td>
<td>3</td>
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<tr>
<td>Control Engineering I Laboratory (EECS 305)</td>
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<td>Engineering Optimization (EECS 346)</td>
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<td>Signal Processing (EECS 313)</td>
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<td>Computer Simulation (OPRE 432)</td>
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<table>
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<tr>
<td>Professional Communication for Engineers (ENGR 398)**</td>
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<td>Engineering Economics and Decision Analysis (EECS 352)</td>
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<td>Engineering Projects I (EECS 398)b</td>
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<td>Approved technical electivec</td>
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<td>HM/SS elective**</td>
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<tr>
<td>Engineering Projects II (EECS 399)b</td>
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<tr>
<td>Approved technical electivec</td>
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<tr>
<td>Approved technical electivec</td>
<td>3</td>
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<tr>
<td>Approved technical electivec</td>
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<td>Year Total:</td>
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Total Units in Sequence: 129

<table>
<thead>
<tr>
<th>Hours Required for Graduation: 129</th>
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<tbody>
<tr>
<td>* University general education requirement</td>
</tr>
<tr>
<td>** Engineering general education requirement</td>
</tr>
<tr>
<td>a Selected students may be invited to take PHYS 123 and 124 in place of PHYS 121 and 122.</td>
</tr>
<tr>
<td>b Co-op students may obtain design credit for one semester of Senior Project Lab if their co-op assignment includes significant design responsibility. This credit can be obtained by submitting a suitable written report and making an oral presentation on the co-op work in coordination with the senior project instructor</td>
</tr>
<tr>
<td>c Technical electives from approved list of courses in the three tracks/program concentration areas (Energy systems, Control systems, and Data Analytics) listed under “Depth Requirement” above. There are five technical elective courses available within the B.S. program in systems and control engineering curriculum that represent a depth of the discipline. Students can satisfy these four technical elective requirements by choosing three courses from one of the three tracks (to meet the Depth Requirement) with the fourth and fifth courses chosen from any of the three tracks listed under the Depth Requirement section above</td>
</tr>
</tbody>
</table>

Dual Major: Systems and Control Engineering & Electrical Engineering

From Systems and Control Engineering (S&CE) to Electrical Engineering (EE): S&CE students can earn a double major with EE by taking the following five courses as Technical Electives in the S&CE program:

- EECS 281 Logic Design and Computer Organization
- EECS 245 Electronic Circuits
- EECS 309 Electromagnetic Fields I
- EECS 321 Semiconductor Electronic Devices
- EECS 375 Applied Control

As the three courses EECS 281, EECS 245, and EECS 321 are 4 credit-hours instead of 3, the three credit-hour “Open Elective” course in the original S&CE program is not needed.

Cooperative Education Program (http://engineering.case.edu/coop) in Systems and Control Engineering

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop.

Alternatively or additionally, students may obtain employment as summer interns.

BS/MS Program in Systems and Control Engineering

The department encourages highly motivated and qualified students to apply for admission to the five-year BS/MS Program in the junior year. This integrated program, which permits up to 9 credit hours of graduate level coursework to be counted towards both BS and MS degree requirements (including an option to substitute MS thesis work for EECS 399 Engineering Projects II, the second senior project). It also offers the opportunity to complete both the Bachelor of Science in Engineering and Master of Science degrees within five years. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

Minor Program in Systems and Control Engineering

A total of five courses (15 credit hours) are required to obtain a minor in systems and control engineering. This includes

- EECS 246 Signals and Systems

- EECS 281 Logic Design and Computer Organization
- EECS 245 Electronic Circuits
- EECS 309 Electromagnetic Fields I
- EECS 321 Semiconductor Electronic Devices
- EECS 375 Applied Control

As the three courses EECS 281, EECS 245, and EECS 321 are 4 credit-hours instead of 3, the three credit-hour “Open Elective” course in the original S&CE program is not needed.

Cooperative Education Program (http://engineering.case.edu/coop) in Systems and Control Engineering

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop.

Alternatively or additionally, students may obtain employment as summer interns.

BS/MS Program in Systems and Control Engineering

The department encourages highly motivated and qualified students to apply for admission to the five-year BS/MS Program in the junior year. This integrated program, which permits up to 9 credit hours of graduate level coursework to be counted towards both BS and MS degree requirements (including an option to substitute MS thesis work for EECS 399 Engineering Projects II, the second senior project). It also offers the opportunity to complete both the Bachelor of Science in Engineering and Master of Science degrees within five years. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

Minor Program in Systems and Control Engineering

A total of five courses (15 credit hours) are required to obtain a minor in systems and control engineering. This includes

- EECS 246 Signals and Systems

- EECS 281 Logic Design and Computer Organization
- EECS 245 Electronic Circuits
- EECS 309 Electromagnetic Fields I
- EECS 321 Semiconductor Electronic Devices
- EECS 375 Applied Control

As the three courses EECS 281, EECS 245, and EECS 321 are 4 credit-hours instead of 3, the three credit-hour “Open Elective” course in the original S&CE program is not needed.
• Three of the following four courses selected in consultation with
  the program minor advisor: EECS 304 Control Engineering I with
  Laboratory/EECS 305 Control Engineering I Laboratory; EECS 324
  Modeling and Simulation of Continuous Dynamical Systems;
  EECS 346 Engineering Optimization; EECS 352 Engineering
  Economics and Decision Analysis;
• One of EECS 313 Signal Processing, EECS 351 Communications and
  Signal Analysis, or EECS 354 Digital Communications.

Bachelor of Science in Computer Engineering

The Bachelor of Science program in Computer Engineering is designed to
provide students a strong background in the fundamentals of computer
engineering through combined classroom and laboratory work. A
graduate of this program will be able to use these fundamentals to
analyze and evaluate computer systems, both hardware and software.
A computer engineering graduate would also be able to design and
implement a computer system for general purpose or embedded
computing incorporating state-of-the-art solutions to a variety of
computing problems. This includes systems which have both hardware
and software component, whose design requires a well-defined interface
between the two, and the evaluation of the associated trade-offs.

Mission

The educational mission of the computer engineering program is to
generate graduates who have fundamental technical knowledge of their
profession along with requisite technical breadth and communications
skills to become leaders in creating the new techniques and technologies
which will advance the general field of computer engineering. Core
courses provide our students with a strong background in digital systems
design, computer organization, hardware architecture, and digital
electronics.

Program Educational Objectives

1. Graduates will be successful professionals obtaining positions
   appropriate to their background, interests, and education.
2. Graduates will engage in life-long learning to improve and enhance
   their professional skills.
3. Graduates will demonstrate leadership in their profession using their
   knowledge, communication skills, and engineering ability.

Student Outcomes

As preparation for achieving the above educational objectives, the BS
degree program in Computer Engineering is designed so that students
attain:
• an ability to apply knowledge of mathematics, science, and
  engineering
• an ability to design and conduct experiments, as well as to analyze
  and interpret data
• an ability to design a system, component, or process to meet desired
  needs within realistic constraints such as economic, environmental,
  social, political, ethical, health and safety, manufacturability, and
  sustainability
• an ability to function on multi-disciplinary teams
• an ability to identify, formulate, and solve engineering problems
• an understanding of professional and ethical responsibility
• an ability to communicate effectively
• the broad education necessary to understand the impact of
  engineering solutions in a global, economic, environmental, and
  societal context
• a recognition of the need for, and an ability to engage in life-long
  learning
• a knowledge of contemporary issues
• an ability to use the techniques, skills, and modern engineering tools
  necessary for engineering practice.

Major in Computer Engineering

In addition to engineering general education requirements
(p. 1072) and university general education requirements (p. 1053), the
major requires the following courses:

Major Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 132</td>
<td>Introduction to Programming in Java</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 210</td>
<td>Introduction to Circuits and Instrumentation</td>
<td>4</td>
</tr>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 301</td>
<td>Digital Logic Laboratory</td>
<td>2</td>
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<tr>
<td>EECS 302</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 314</td>
<td>Computer Architecture</td>
<td>3</td>
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<tr>
<td>EECS 315</td>
<td>Digital Systems Design</td>
<td>4</td>
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<tr>
<td>One of the following:</td>
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<td></td>
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<tr>
<td>EECS 318</td>
<td>VLSI/CAD</td>
<td>4</td>
</tr>
<tr>
<td>EECS 338</td>
<td>Intro to Operating Systems and Concurrent Programming</td>
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</table>

Statistics Requirement

One Statistics elective may be chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
<td>3</td>
</tr>
<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
<td>3</td>
</tr>
<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>STAT 333</td>
<td>Uncertainty in Engineering and Science</td>
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Design Requirement

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<tr>
<td>EECS 398</td>
<td>Engineering Projects I</td>
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</table>

In consultation with a faculty advisor, a student completes the program
by selecting technical and open elective courses that provide in-depth
training in principles and practice of computer engineering. With
the approval of the advisor, a student may emphasize a specialty of
his/her choice by selecting elective courses from other programs or
departments.

Many courses have integral or associated laboratories in which students
gain “hands-on” experience with computer engineering principles and
instrumentation. Students have ready access to the teaching laboratory
facilities and are encouraged to use them during nonscheduled hours in
addition to the regularly scheduled laboratory sessions. Opportunities
also exist for undergraduate student participation in the wide spectrum of
research projects being conducted in the department.
Suggested Program of Study: Major in Computer Engineering

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

First Year

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Units</th>
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<tbody>
<tr>
<td>SAGES First Year Seminar</td>
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<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
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<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
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<tr>
<td>Introduction to Programming in Java (EECS 132)**</td>
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<tr>
<td>Open elective</td>
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<td>PHED (2 half semester courses)*</td>
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<td>SAGES University Seminar*</td>
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<td>General Physics I - Mechanics (PHYS 121)**</td>
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<tr>
<td>Calculus for Science and Engineering II (MATH 122)**</td>
<td>4</td>
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<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
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<tr>
<td>PHED (2 half semester courses)*</td>
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Second Year

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<td>General Physics II - Electricity and Magnetism (PHYS 122)**</td>
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<td>Calculus for Science and Engineering III (MATH 223)**</td>
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<td>Introduction to Data Structures (EECS 233)</td>
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<tr>
<td>Elementary Differential Equations (MATH 224)**</td>
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<td>Statics and Strength of Materials (ENGR 200)**</td>
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<td>Logic Design and Computer Organization (EECS 281)</td>
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Third Year

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<tr>
<td>Discrete Mathematics (EECS 302)</td>
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<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**</td>
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<td>Technical electivea</td>
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<td>Professional Communication for Engineers (ENGL 398)**</td>
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<td>Professional Communication for Engineers (ENGR 398)**</td>
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<td>Digital Logic Laboratory (EECS 301)</td>
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<td>Computer Architecture (EECS 314)</td>
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<td>Digital Systems Design (EECS 315)</td>
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<td>Intro to Operating Systems and Concurrent Programming (EECS 338) or Technical elective,3**</td>
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Fourth Year

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</table>

Total Units in Sequence: 129

Hours Required for Graduation: 129

- University general education requirement
- Engineering general education requirement
- Technical electives are more generally defined as any course related to the principles and practice of computer engineering. This includes all EECS courses at the 200 level and above, and can include courses from other programs. All non-EECS technical electives must be approved by the student's advisor.
- The student must take either EECS 318 VLSI/CAD (Fall Semester) EECS 338 Intro to Operating Systems and Concurrent Programming (Spring Semester), or a three credit hour technical elective.
- May be taken in the Fall semester if the student would like to take %3Ccourseinline id="8">EECS 399%7C in the Spring semester.

Cooperative Education (http://engineering.case.edu/coop) Program in Computer Engineering

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

BS/MS Program in Computer Engineering

Highly motivated and qualified students are encouraged to apply to the BS/MS Program which will allow them to get both degrees in five years. The BS can be in Computer Engineering or a related discipline, such as mathematics or electrical engineering. Integrating graduate study in computer engineering with the undergraduate program allows a student to satisfy all requirements for both degrees in five years. Review the
Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

**Minor in Computer Engineering**

The department also offers a minor in computer engineering. The minor has a required two course sequence followed by a two course sequence in either hardware or software aspects of computer engineering. The following two courses are required for any minor in computer engineering:

- **EECS 281** Logic Design and Computer Organization
- **EECS 233** Introduction to Data Structures

Students should note that EECS 132 Introduction to Programming in Java is a prerequisite for EECS 233 Introduction to Data Structures.

The two-course hardware sequence is:

- **EECS 314** Computer Architecture
- **EECS 315** Digital Systems Design

The corresponding two-course software sequence is:

- **EECS 338** Intro to Operating Systems and Concurrent Programming
- **EECS 3XX Approved by advisor**

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**Computer Science**

**Mission**

The mission of the Bachelor of Science and Bachelor of Arts programs in Computer Science is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies which will advance the field of computer science and its application to other disciplines.

**Program Educational Objectives**

1. To educate and train students in the fundamentals of computer science and mathematics, in order to analyze and solve computing problems, as demonstrated by their professional accomplishments in industry, government and graduate programs and measured within three to five years after graduation.

2. To educate students with an understanding of real-world computing needs, as demonstrated by their ability to address technical issues involving computing problems encountered in industry, government and graduate programs and measured within three to five years after graduation.

3. To train students to work effectively, professionally and ethically in computing-related professions, as demonstrated by their communications, teamwork and leadership skills in industry, government and graduate programs and measured within three to five years after graduation.

**Student Outcomes**

As preparation for achieving the above educational objectives, the BS and BA degree programs in Computer Science are designed so that Bachelor of Science students attain:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
- An ability to function effectively on teams to accomplish a common goal
- An understanding of professional, ethical, and social responsibilities
- An ability to communicate effectively
- An ability to analyze the impact of computing on individuals, organizations, and society, including ethical, legal, security, and global policy issues
- Recognition of the need for and an ability to engage in continuing professional development
- An ability to use current techniques, skills, and tools necessary for computing practice
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices
- An ability to apply design and development principles in the construction of software systems of varying complexity

Core and breadth courses provide our students with the flexibility to work across many disciplines and prepare them for a variety of professions. Our curriculum is designed to teach fundamental skills and knowledge needed by all CS graduates, while providing the greatest flexibility in selecting topics. Students are also required to develop depth in at least one of the following technical areas: software engineering; algorithms and theory; computer systems, networks, and security; databases and data mining; bioinformatics; or artificial intelligence.

**Bachelor of Science in Computer Science**

The Bachelor of Science program in Computer Science is designed to give a student a strong background in the fundamentals of mathematics and computer science. The curriculum is designed according to the latest ACM/IEEE computer science curriculum guidelines. A graduate of this program should be able to use these fundamentals to analyze and evaluate software systems and the underlying abstractions upon which they are based. A graduate should also be able to design and implement software systems which are state-of-the-art solutions to a variety of computing problems; this includes problems which are sufficiently complex to require the evaluation of design alternatives and engineering trade-offs. In addition to these program specific objectives, all students in the Case School of Engineering are exposed to societal issues, professionalism, and are provided opportunities to develop leadership skills.

**Bachelor of Arts in Computer Science**

The Bachelor of Arts program in Computer Science is a combination of a liberal arts program and a computing major. It is a professional program in the sense that graduates can be employed as computer professionals, but it is less technical than the Bachelor of Science program in Computer Science. This degree is particularly suitable for students with a wide range of interests. For example, students can major in another discipline in addition to computer science and routinely complete all of the requirements for the double major in a 4 year period. This is possible because over a third of the courses in the program are open electives. Furthermore, if a student is majoring in computer science...
and a second technical field such as mathematics or physics many of the technical electives will be accepted for both majors. Another example of the utility of this program is that it routinely allows students to major in computer science and take all of the pre-med courses in a four-year period.

**Major in Computer Science (BS and BA)**

**BS Degree.** Each student is required to complete a total of 14 CS courses. CS courses consist of the courses listed in the core, breadth, and depth areas below. BS students must complete: all 6 core courses; 5 of 7 breadth courses; and at least 4 courses in one of listed depth areas, including all starred courses in that area (many of these also count toward the breadth requirement). Each student is also required to complete 5 technical electives. These can be satisfied using courses from the list of approved technical electives, additional breadth or depth courses, or from other CS-related courses with prior permission from the student’s academic advisor.

**BA Degree.** Students are required to complete a total of 9 CS courses. BA students must complete: all 6 core courses; 3 of 7 breadth courses; and 4 technical electives. There is no depth requirement for the BA degree.

**Major Requirements**

In addition to engineering general education requirements (BS) (p. 1072), arts & sciences general education requirements (BA) (p. 1055) and university general education requirements (p. 1053), the major requires the following courses:

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<thead>
<tr>
<th>Course</th>
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<td>EECS 233</td>
<td>Introduction to Data Structures</td>
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<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
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<td>EECS 302</td>
<td>Discrete Mathematics</td>
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<td>Professional Communication for Engineers</td>
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<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
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</table>
MATH 408  Introduction to Cryptology  3

Recommended preparation: MATH 380, MATH 201 or (MATH 307 and MATH 308), PHIL 306.

**Area 3: Computer Systems, Networks and Security**
- EECS 325  Computer Networks I  *  3
- EECS 338  Intro to Operating Systems and Concurrent Programming  4
- EECS 441  Internet Applications  3
- EECS 337  Compiler Design  4
- EECS 444  Computer Security  3
- MATH 408  Introduction to Cryptology  3

**Area 4: Databases and Data Mining**
- EECS 341  Introduction to Database Systems  *  3
- EECS 339  Web Data Mining  3
- EECS 405  Data Structures and File Management  3
- EECS 433  Database Systems  3
- EECS 435  Data Mining  3
- EECS 440  Machine Learning  3
- EECS 454  Analysis of Algorithms  3

**Area 5: Bioinformatics**
- EECS 458  Introduction to Bioinformatics  *  3
- EECS 459  Bioinformatics for Systems Biology  *  3
- EECS 341  Introduction to Database Systems  3
- EECS 435  Data Mining  3
- EECS 440  Machine Learning  3
- EECS 454  Analysis of Algorithms  3

Recommended breadth and preparation: STAT 325 or EPBI 431, SYBB 311, BIOL 214. Students completing the bioinformatics depth area are only required to complete two out the three starred courses plus two additional courses on the list.

**Area 6: Artificial Intelligence**
- EECS 391  Introduction to Artificial Intelligence  *  3
- EECS 440  Machine Learning  3
- EECS 442  Causal Learning from Data  3
- EECS 484  Computational Intelligence I: Basic Principles  3
- EECS 491  Artificial Intelligence: Probabilistic Graphical Models  3
- EECS 496  Artificial Intelligence: Sequential Decision Making  3
- EECS 497  Artificial Intelligence: Statistical Natural Language Processing  3
- EECS 499  Algorithmic Robotics  3
- EECS 531  Computer Vision  3

Recommended breadth and preparation: MATH 201, MATH 380, and either EECS 416 or EECS 477.

**Technical Electives**
Computer Science BS students are required to complete a total of 5 technical electives, totaling at least 14 credit hours; CS BA students are required to complete 4, totaling at least 11 credit hours. Technical electives are divided into two groups according to how closely a course is related to the core knowledge areas as defined in the ACM/IEEE computer science curriculum guidelines. CS students may complete any (or all) of their technical electives from group 1 and have the option to satisfy up to two of their technical electives from group 2. Students may also satisfy any of their technical elective requirements by taking additional breadth or depth courses listed above. CS-related courses not listed below may count toward the technical elective requirement but require prior permission from the student’s academic advisor.

**Group 1**
- EECS 275  Fundamentals of Robotics  4
- EECS 290  Introduction to Computer Game Design and Implementation  3
- EECS 301  Digital Logic Laboratory  2
- EECS 315  Digital Systems Design  4
- EECS 316  Computer Design  3
- EECS 318  VLSI/CAD  4
- EECS 366  Computer Graphics  3
- EECS 376  Mobile Robotics  4
- EECS 390  Advanced Game Development Project  3
- EECS 419  Computer System Architecture  3
- EECS 485  VLSI Systems  3
- EECS 488  Embedded Systems Design  3
- EECS 490  Digital Image Processing  3

**Group 2**
- EECS 245  Electronic Circuits  4
- EECS 246  Signals and Systems  4
- EECS 304  Control Engineering I with Laboratory  3
- EECS 305  Control Engineering I Laboratory  1
- EECS 309  Electromagnetic Fields I  3
- EECS 313  Signal Processing  3
- EECS 319  Applied Probability and Stochastic Processes for Biology  3
- EECS 324  Modeling and Simulation of Continuous Dynamical Systems  3
- EECS 354  Digital Communications  3
- EECS 375  Applied Control  3
- EECS 408  Introduction to Linear Systems  3
- EECS 413  Nonlinear Systems I  3
- EECS 489  Robotics I  3
- ENGR 210  Introduction to Circuits and Instrumentation  4
- MATH 201  Introduction to Linear Algebra for Applications  3
- MATH 303  Elementary Number Theory  3
- MATH 307  Linear Algebra  3
- MATH 308  Introduction to Abstract Algebra  3
- MATH 330  Introduction of Scientific Computing  3
- MATH 406  Mathematical Logic and Model Theory  3
- MATH 413  Graph Theory  3
Bachelor of Science
Suggested Program of Study: Major in Computer Science

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

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Total Units in Sequence: 127

Hours Required for Graduation: 127

* University general education requirement
a Chosen from: MATH 380 Introduction to Probability, STAT 312 Basic Statistics for Engineering and Science, STAT 313 Statistics for Engineers, STAT 332 Statistics for Signal Processing, STAT 333 Uncertainty in Engineering and Science
b Chosen from the list of CS technical electives. All other technical electives must be approved by the student's advisor.
c Each student must complete 5 of the 7 following courses: EECS 314, EECS 325, EECS 338, EECS 341, EECS 345, EECS 391, and EECS 393. EECS 338 is a 4 unit course.
d Each student must complete 4 courses in one of the technical depth areas listed above, including all starred courses.
e Needed to complete the requirement of 14 CS courses. This can be an additional breadth or depth course, depending on what is needed to satisfy the depth requirement.

Bachelor of Arts
Suggested Program of Study: Major in Computer Science

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<thead>
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<th>First Year</th>
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<td>Course</td>
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**Second Year**

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**Third Year**

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<tr>
<td>Professional Communication for Engineers (ENGL 398)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGR 398)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Technical elective$^a$</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective$^a$</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Breadth elective$^b$</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Breadth elective$^b$</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

**Fourth Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithms (EECS 340)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective$^a$</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Senior Project in Computer Science (EECS 395)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Technical elective$^b$</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

**Total Units in Sequence:**

- **Fall:** 17
- **Spring:** 16
- **Total:** 120

**Hours Required for Graduation:** 120

$^a$ University general education requirement

$^b$ Chosen from the list of approved CS technical electives. All other technical electives must be approved by the student’s advisor.

Each student must complete 3 of the 7 following courses: EECS 314, EECS 325, EECS 338, EECS 341, EECS 345, EECS 391, and EECS 393. EECS 338 is a 4 unit course.

**Cooperative Education Program** ([http://engineering.case.edu/coop](http://engineering.case.edu/coop)) **in Computer Science**

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

**BS/MS Program in Computer Science**

Students with a grade point average of 3.2 or higher are encouraged to apply to the BS/MS Program which will allow them to get both degrees in five years. The BS can be in Computer Science or a related discipline, such as mathematics or electrical engineering. Integrating graduate study in computer science with the undergraduate program allows a student to satisfy all requirements for both degrees in five years. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

**Minor in Computer Science (BS or BSE)**

For students pursuing a BS or BSE degree, the following three courses are required for a minor in computer science:

- EECS 132 Introduction to Programming in Java 3
- EECS 233 Introduction to Data Structures 4
- EECS 302 Discrete Mathematics 3
- EECS 340 Algorithms 3

A student must take an additional 4 credit hours of CS Courses (see Major Requirements) with the exclusion of ENGR 131 Elementary Computer Programming.

**Minor in Computer Science (BA)**

For students pursuing BA degrees, the following courses are required for a minor in computer science:

- EECS 132 Introduction to Programming in Java 3
- EECS 233 Introduction to Data Structures 4
Two additional CS Courses (see Major Requirements) are required for this minor.

**Minor in Artificial Intelligence**

The minor consists of five courses. Every student who takes the minor in artificial intelligence must take the two courses, ENGR 131 Elementary Computer Programming and EECS 391 Introduction to Artificial Intelligence. Students who take the Artificial Intelligence minor must also take an additional three courses from one of two minor tracks.

**Technology Track (requires 3 of the following courses):**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 373</td>
<td>Introduction to Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 374</td>
<td>Neurobiology of Behavior</td>
<td>3</td>
</tr>
<tr>
<td>EECS 477</td>
<td>Advanced Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>EECS/BIOL 478</td>
<td>Computational Neuroscience</td>
<td>3</td>
</tr>
<tr>
<td>EECS 350</td>
<td>Operations and Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>EECS 352</td>
<td>Engineering Economics and Decision Analysis</td>
<td>3</td>
</tr>
<tr>
<td>EECS 360</td>
<td>Manufacturing and Automated Systems</td>
<td>3</td>
</tr>
<tr>
<td>EECS 375</td>
<td>Applied Control</td>
<td>3</td>
</tr>
<tr>
<td>EECS 411</td>
<td>Applied Engineering Statistics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 475</td>
<td>Applied Control</td>
<td>3</td>
</tr>
<tr>
<td>EECS 484</td>
<td>Computational Intelligence I: Basic Principles</td>
<td>3</td>
</tr>
<tr>
<td>EECS 489</td>
<td>Robotics I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 491</td>
<td>Artificial Intelligence: Probabilistic Graphical Models</td>
<td>3</td>
</tr>
<tr>
<td>EECS 531</td>
<td>Computer Vision</td>
<td>3</td>
</tr>
<tr>
<td>EECS 589</td>
<td>Robotics II</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 201</td>
<td>Introduction to Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 306</td>
<td>Mathematical Logic and Model Theory</td>
<td>3</td>
</tr>
</tbody>
</table>

**Cognitive Science Track (requires 3 of the following courses):**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 373</td>
<td>Introduction to Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 374</td>
<td>Neurobiology of Behavior</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 301</td>
<td>Linguistic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 201</td>
<td>Introduction to Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 306</td>
<td>Mathematical Logic and Model Theory</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 101</td>
<td>General Psychology I</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 352</td>
<td>Physiological Psychology</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 353</td>
<td>Psychology of Learning</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 355</td>
<td>Sensation and Perception</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 357</td>
<td>Cognitive Psychology</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 370</td>
<td>Human Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 402</td>
<td>Cognition and Information Processing</td>
<td>3</td>
</tr>
</tbody>
</table>

**Minor in Computer Gaming (CGM)**

The minor is 16 hours as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 290</td>
<td>Introduction to Computer Game Design and Implementation</td>
<td>3</td>
</tr>
<tr>
<td>EECS 366</td>
<td>Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 390</td>
<td>Advanced Game Development Project</td>
<td>3</td>
</tr>
<tr>
<td>EECS 391</td>
<td>Introduction to Artificial Intelligence</td>
<td>3</td>
</tr>
</tbody>
</table>

It is recommended that one additional open elective be a "content creation" course taken from the following areas: Art, English, or Music. Students should note that EECS 132 Introduction to Programming in Java is a prerequisite for EECS 233 Introduction to Data Structures.

**Graduate Programs**

**M.S. Degree Program (Electrical Engineering, Computer Engineering, Systems and Control Engineering)**

**Admission**

Graduate students shall be admitted to one of two M.S. degree programs (Plan A or Plan B) upon recommendation of the faculty of the Department. Requirements for admission include a strong record of scholarship in a completed bachelor's degree program in a field of engineering, mathematical or physical sciences, and fluency in written and spoken English. The University requires all foreign applicants to show English proficiency by achieving a TOEFL score of at least 577 on the paper-based exam or 90 on the internet-based exam. It is required that all students submit original copies of GRE scores, with the exception of CWRU students applying to the B.S./M.S. program. Applications from students with a bachelor's degree in fields other than those listed above may be granted admission on a provisional basis. Such provisional students may be advanced to full standing upon completion of prerequisite conditions stipulated in the letter of admission.

**Registration**

Course registration is performed through the SIS system. Each semester before registration, students should update any personal information that may have changed by logging onto the SIS and editing the appropriate information. All registration holds must be lifted in order to successfully complete the registration process.

**Advising**

Upon admission to the graduate program, each graduate student is assigned an academic advisor to assist in registration as well as planning a program of study. This is a temporary assignment made by the Department Chairperson based on the student's academic and research interests as identified at the time of application. During the first semester in the program, it is strongly suggested that each student meet with various members of faculty to discuss academic objectives/goals and research opportunities. In order to complete the research component of their respective degree program, each student must identify a faculty member who is willing to serve as the student's research advisor. The research advisor will also serve as the student's permanent academic advisor if he/she is a member of the department faculty. If, however, the research advisor is not a member of the department faculty, the student is required to find a permanent academic advisor from the department faculty. For students enrolled in the M.S. Plan A degree program, the research advisor is commonly known as the "thesis advisor".

Students may change advisors for a variety of reasons of which one of the most common is a change of the student's field of interest. It should be noted that a change in research advisor may require that the student start a new research project, which could result in delaying graduation. It
is the responsibility of the student to inform the EECS Office of Student Affairs in the event of a change in advisor. In addition, the student must file all appropriate forms with Graduate Studies.

The M.S. Plan A Degree Program

The M.S. Plan A degree program is composed of two components: (1) graduate-level coursework and (2) a research-oriented thesis. Progression through the program is monitored by a Program of Study. Each M.S. Plan A student is required to file a Program of Study through SIS. The Program of Study contains a comprehensive list of all courses to be applied to the degree (including transfer courses), and must be approved by his/her academic advisor, Department Chairperson, and Dean of Graduate Studies. The Program of Study must contain at least 27 semester credit hours of coursework at the 400 level or above, of which a minimum of 18 credits must be from non-thesis related courses. Each M.S. Plan A student must complete at least 9 credit hours of EECS 651 Thesis M.S., which is the course associated with M.S. thesis research. Each student must complete an approved Program of Study with a cumulative grade point average of 3.0 or greater. Full-time M.S. students are recommended to file a Program of Study before the beginning of the second semester.

Completion of the M.S. Plan A degree requires that the student submit a written thesis and make an oral presentation of the findings (hereafter known as the defense) to a thesis guidance committee. The thesis guidance committee shall consist of the student’s research advisor and at least two additional faculty members recommended by the advisor. At least two members of the committee must be faculty members in the EECS department. The chairperson of the guidance committee is normally the candidate’s research advisor. The student is responsible for forming the thesis guidance committee. The student will work closely with his/her advisor to determine when the thesis is ready for review by the guidance committee. The student shall provide an announcement containing a title, abstract, date, time and location of the defense to the EECS Office of Student Affairs for general distribution at least 10 days in advance of the thesis defense.

The M.S. Plan B Degree Program

The M.S. Plan B degree program is composed of two components: (1) graduate-level coursework and (2) a research-oriented project. Progression through the program is monitored by a Program of Study. Each M.S. Plan B student is required to file a Program of Study through SIS. The Program of Study contains a comprehensive list of all courses to be applied to the degree (including transfer courses), and must be approved by his/her academic advisor, Department Chairperson, and Dean of Graduate Studies. The Program of Study must contain at least 27 semester credit hours of coursework at the 400 level or above, of which a minimum of 21 credits must be from courses other than EECS 649 Project M.S. (which is the course associated with M.S. research project). A M.S. Plan B student must complete at least 3 credit hours of EECS 649 Project M.S.. Each student must complete an approved Program of Study with a cumulative grade point average of 3.0 or greater. Full-time students are strongly recommended to file a Program of Study before the beginning of the second semester.

Each candidate for the master’s degree under Plan B must pass a comprehensive examination to be administered by a committee of department faculty. The examination committee should be composed of the student’s academic advisor and at least two additional members of the department faculty. In such cases, the chairperson of the committee is normally the candidate’s academic advisor. The examination may be written, oral or a combination as determined by the committee. A student must be registered during the semester in which any part of the comprehensive examination is taken. If not registered for other courses, the student will be required to register for one semester hour of EXAM 600, Comprehensive Examination, before taking the examination.

Appeals

Any decision by an academic advisor, thesis guidance committee, or department associate chairperson may be appealed, in writing, to the department associate chairperson who shall present the appeal, with his recommendations, to the faculty at its next regular faculty meeting. The faculty’s decision shall be final.

Other Regulations

All students pursuing graduate studies in the Department of Electrical Engineering and Computer Science must abide by the academic regulations of the School of Graduate Studies and the Case School of Engineering contained in the most recent issue of the Bulletin of Case Western Reserve University, and supplemented by the Department of Electrical Engineering and Computer Science regulations.

NOTE: The above regulations apply to graduate students who entered the degree programs in computer engineering, electrical engineering, and systems & control engineering after January 1, 2005.

Computer Science

MS Degree Program (Computer and Information Science)

As provided for by the School of Graduate Studies, there are two plans for the Master of Science degree, each requiring 27 semester hours of credit. Plan A requires 9 semester hours of thesis (EECS 651 Thesis M.S.) and 18 semester hours of courses. Plan B requires a 6 semester hour project (EECS 649 Project M.S.) and 21 semester hours of course credit. Plan B is normally restricted to part-time students or students in the BS/MS program with the approval of their project advisors. (A BS/MS student who follows plan B is required to do a two-semester 6 credit hours MS project.)

All coursework must be at the 400-level or higher. Students must achieve a grade point average of 3.0 or higher; it is computed for all of the courses, excluding project and thesis credits, on the student’s program of study.

Each M.S. student has a faculty advisor who assists the student in formulating a program of study. Initially, the advisor is the chair of the CS graduate committee. Students are expected to pick a research advisor by the end of their first semester in the program who will supervise their thesis or project. Each student, in consultation with their advisor, must submit a Planned Program of Study preferably before completing 9 credit hours of coursework.

Both the thesis and the Plan B project require a formal written report, as well as a final oral examination by a committee of at least three faculty members, two of whom must be primarily affiliated with the CS program. A student whose thesis is supervised by someone not primarily affiliated with the CS program must also have a faculty co-advisor in the CS program. For Plan B students, the oral examination fulfills the Comprehensive Examination requirement of the School of Graduate Studies.

When applying to this program, please select the CIS (Computing and Information Sciences) program option in your application.
Course Requirements
The M. S. program in Computer Science requires students to have substantial knowledge of undergraduate computer science material. This includes knowledge in data structures, algorithms and operating systems equivalent to that in the courses:

EECS 233 Introduction to Data Structures

EECS 340 Algorithms

EECS 338 Intro to Operating Systems and Concurrent Programming

This requirement is normally satisfied by taking courses at the student’s undergraduate university which contain most of the material in the above courses. Students deficient in one or more of these areas may be required to satisfy this requirement by taking the corresponding course listed above. A student taking and passing a more advanced course in an area automatically demonstrates knowledge of the material in the area; e.g. taking EECS 454 Analysis of Algorithms demonstrates knowledge of the material in EECS 340 Algorithms.

Students are required to have specialized knowledge in at least one of the following tracks, by taking at least three graduate level classes from that track. The list of acceptable classes is shown below. Generally, the chosen track should correspond to the student's thesis research area or project. The remaining classes can be (i) any other class from the classes listed below, or (ii) any CS-related class offered by EECS, or (iii) graduate level classes in other departments necessary for the student’s research or project. At most two classes can be from the third category.

List of tracks and corresponding courses

1. Software Engineering:
   a. EECS 441 Internet Applications
   b. EECS 442 Causal Learning from Data
   c. EECS 444 Computer Security
   d. EECS 466 Computer Graphics
   e. EECS 493 Software Engineering

2. Algorithms & Theory:
   a. EECS 440 Machine Learning
   b. EECS 454 Analysis of Algorithms
   c. EECS 477 Advanced Algorithms
   d. MATH 408 Introduction to Cryptology

3. Computer Systems, Networks and Security:
   a. EECS 425 Computer Networks I
   b. EECS 441 Internet Applications
   c. EECS 444 Computer Security
   d. MATH 408 Introduction to Cryptology

4. Databases and Data Mining:
   a. EECS 405 Data Structures and File Management
   b. EECS 433 Database Systems
   c. EECS 435 Data Mining
   d. EECS 439 Web Data Mining
   e. EECS 440 Machine Learning

5. Bioinformatics:
   a. EECS 435 Data Mining

b. EECS 440 Machine Learning
c. EECS 454 Analysis of Algorithms
d. EECS 458 Introduction to Bioinformatics
e. EECS 459 Bioinformatics for Systems Biology

6. Artificial Intelligence:
   a. EECS 440 Machine Learning
   b. EECS 442 Causal Learning from Data
c. EECS 484 Computational Intelligence I: Basic Principles
d. EECS 491 Artificial Intelligence: Probabilistic Graphical Models
e. EECS 496 Artificial Intelligence: Sequential Decision Making
f. EECS 497 Artificial Intelligence: Statistical Natural Language Processing
g. EECS 499 Algorithmic Robotics
h. EECS 531 Computer Vision

Master of Science - Optional Specialization

Wearable Computing
The MS degree in Electrical Engineering (EE) with a specialization in Wearable Computing may be completed as a "course-only" option program of study. Students who complete this 9-course, 27-credit course-only option will have the requisite knowledge to enter and advance the wearable computing industry.

Wireless Health
The MS degree in Electrical Engineering (EE) with a specialization in Wireless Health is a "course-only" option program of study. Students who complete this 9-course, 27-credit course-only option will have the requisite knowledge to enter and advance the wireless health industry, with a greater emphasis on the technology aspects.

For more details, please refer to the Master's Degree (http://engineering.case.edu/sandiego/ms) information on the Case School of Engineering - San Diego website.

Ph.D. Graduate Student Requirements (Electrical Engineering, Computer Engineering, Systems and Control Engineering)

These regulations are in addition to the Academics Regulations of the School of Graduate Studies and the Specific Requirements for the Ph.D. Degree of the Graduate Program in the Case School of Engineering as found in the General Catalog of Case Western Reserve University.

Admission
Requirements for admission include a strong record of scholarship in a completed bachelor's degree program in a field of engineering, mathematical or physical sciences, and fluency in written and spoken English. The University requires all foreign applicants to show English proficiency by achieving a TOEFL score of at least 577 on the paper-based exam or 90 on the internet-based exam. It is required that all students submit original copies of GRE scores. Applications from students with a bachelor’s degree in fields other than those listed above may be granted admission on a provisional basis. Such provisional students may be advanced to full standing upon completion of prerequisite conditions stipulated in the letter of admission.

Registration
Course registration is performed through SIS. Each semester before registration, students should update any personal information that may have changed by logging onto the SIS and editing the appropriate
information. All registration holds must be lifted in order to successfully complete the registration process.

Advising

Upon admission to the graduate program, each graduate student is assigned an academic advisor to assist in registration. This is a temporary assignment made by the Department Chairperson based on the student's academic and research interests as identified at the time of application. During the first two semesters in the program, it is strongly suggested that each student meet with various members of faculty to discuss academic objectives/goals and research opportunities. In order to complete the research component of their respective degree program, each student must identify a faculty member who is willing to serve as the student’s research advisor. The research advisor will also serve as the student’s permanent academic advisor if he/she is a member of the department faculty. If, however, the research advisor is not a member of the department faculty, the student is required to find a permanent academic advisor from the department faculty. For students enrolled in the Ph.D program, the research advisor is commonly known as the “dissertation” advisor.

Students may change advisors for a variety of reasons of which one of the most common is a change of the student's field of interest. It should be noted that a change in research advisor may require that the student start a new research project, which could result in delaying graduation. It is the responsibility of the student to inform the EECS Office of Student Affairs in the event of a change in advisor.

The student shall be responsible for forming a dissertation guidance committee which shall consist of the student’s academic advisor and additional faculty members recommended by the advisor. For the Ph.D. program, the minimum number of additional faculty members on the dissertation guidance committee is three, and at least two of the committee must be within the ECSE program areas (Computer Engineering, Electrical Engineering, and Systems and Control Engineering). The chairperson of the guidance committee is normally the candidate’s research advisor. Each student is required to file a Program of Study, which must be approved by the student’s advisor and the Department Chairperson, and submitted to the Dean of Graduate Studies. Full-time Ph.D. students should choose a research advisor and file a Program of Study before taking the qualifier but no later than the beginning of the third semester. Upon passing the qualifier, full time Ph.D. students will be required to assemble the dissertation guidance committee, prepare a dissertation proposal, and present this proposal to the committee for their approval. This process should be completed within one semester of passing the Ph.D. qualifier.

The Ph.D. Degree Program

In order to successfully complete the Ph.D. Degree Program, a student must satisfy the following requirements:

- Select a major dissertation subject area in Electrical Engineering, Computer Engineering, or Systems and Control Engineering
- Fulfill all Ph.D. course requirements in the chosen major area
- Have an approved Program of Study and complete the CWRU courses in the approved Program of Study with a cumulative grade point average of 3.25 or greater
- Successfully complete the Ph.D. Qualifying Examination
- Successfully complete the Ph.D. Proposal Defense
- Successfully complete and defend the Ph.D. Dissertation
- Fulfill the Ph.D. residency requirement

Ph.D. Course Requirements and Program of Study

Each Ph.D. student is required to have a Program of Study, approved by the academic advisor, Department Chairperson, and Dean of Graduate Studies, that includes a minimum of 36 credit hours of coursework beyond the B.S. degree. At least 18 credit hours of coursework must be taken at CWRU. In addition, the student is also required to complete a minimum of 18 credit hours of EECS 701 Dissertation Ph.D. to fulfill the requirement for PhD-level research. Acceptable courses include suitable CWRU courses at the 400 level or higher and approved graduate-level courses taken at other institutions. Students holding a M.S. degree in an appropriate field of study from CWRU or another degree-granting institution may apply up to 18 credit hours of coursework completed for their M.S. degree towards the aforementioned 36 credit hour requirement.

Each Ph.D. student is required to have a fully-approved Program of Study before taking the Ph.D. Qualifying examination and before registering for the final 18 credit hours of the program. The Program of Study shall be prepared by the student and approved by the research advisor or the permanent academic advisor in case where the research advisor is not in the Department.

A Program of Study must meet the following requirements:

- A minimum of two courses in mathematics, statistics, or basic science.
- At least 4 of these courses must be from within the EECS department.
- Four additional courses that are not listed under the student’s major program area. These courses should satisfy the requirement for breadth in the student’s program of study.
- At least 6 approved courses from the student’s major area of study.
- Successful completion of EECS 400T Graduate Teaching I, EECS 500T Graduate Teaching II and EECS 600T Graduate Teaching III.
- Successful completion of the EECS 500 EECS Colloquium requirement (see below)

The above represents the minimum course requirements beyond the B.S. degree. The total number of 3 credit hour courses in the Program of Study is at least 12 (twelve) beyond the B.S. level. The selection of these courses should be done with the guidance from the student’s permanent academic advisor. Any additional courses may be in any one of the above categories as approved by the student’s advisor.

The Ph.D. program includes a colloquium and public presentation requirement. For those who matriculated during or after Fall 2012, the requirement involves passing 3 semesters of EECS 500 EECS Colloquium and a public presentation of their research. Public presentations include conference presentations, department seminars, workshop presentations or similar presentations in a public venue. M.S. thesis and Ph.D. dissertation defenses cannot be used to fulfill the public presentation requirement. It is expected that the EECS 500 EECS Colloquium requirement will be completed before the student applied for Advancement to Candidacy. Alternatively, the student may complete this requirement by giving a presentation as part of the EECS department seminar series. Additional details and the associated forms can be acquired from the EECS Office of Student Affairs. For students who matriculated before Fall 2012, the requirement can be met in one of two ways: (1) completing the requirements detailed above, or (2) passing 5 semesters of EECS 500 EECS Colloquium. Students (such as part-time students working in industry) may propose an alternative arrangement.
for fulfilling this requirement by submitting a written petition to the EECS Graduate Studies Committee.

**Ph.D. Qualifying Examination**
A student shall be admitted to Ph.D. candidacy only after he or she has passed the Ph.D. Qualifying Examination. The Qualifying Exam is intended to test the students' knowledge in the student's chosen major program area: Electrical Engineering, Computer Engineering, or Systems and Control Engineering. The objectives of the exam are:

1. To assess the Ph.D. student's understanding of the fundamental concepts in Electrical Engineering, Computer Engineering, or Systems and Control Engineering, as embodied in the respective graduate curriculum.
2. To ensure that the student have the ability to pursue Ph.D. level research, and have mastered the graduate level coursework necessary to succeed as researchers

Full-time Ph.D. students are recommended to take the Ph.D. qualifier before the beginning of their third semester of full-time (or equivalent) enrollment, and must pass the exam within two years of being admitted to the program. For part-time students, the Qualifying Exam must be passed before more than 27 credit-hours of coursework have been completed. For students who must take remedial courses to make up for shortcomings in their engineering and mathematics knowledge base, the deadline can be extended to the fifth semester of full-time (or equivalent) enrollment, but this requires a petition to the ECSE Graduate Committee. Students have two opportunities to pass the Ph.D. Qualifier. A student who fails to pass the Qualifier after two attempts will not be allowed to continue in the Ph.D. program in the Department of Electrical Engineering and Computer Science. To pass the Ph.D. Qualifier, the student must demonstrate proficiency in two parts:

**Part 1**
The first part of the Ph.D. Qualifier assesses the student's fundamental knowledge and proficiency in the student's major program area:

**Computer Engineering**
Part 1 of the Ph.D. Qualifier will consist of a written examination with questions drawn from several course areas listed below. At least three (3) topic areas must be pursued by the student for a complete qualifier. The exam style is a mini-project oriented, take home test that must be completed with a one week period.

1. EECS 419 Computer System Architecture
2. EECS 425 Computer Networks I
3. EECS 315 Digital Systems Design
4. EECS 488 Embedded Systems Design
5. EECS 485 VLSI Systems
6. EECS 401 Digital Signal Processing

Additional topic areas may be assigned depending on the student interests and their advisors recommendations.

If a student fails all three areas of the written examination, the entire exam must be taken again. If a student fails some areas, the faculty may elect to give another exam to the student in just the areas failed.

The written part of the Qualifying Exam for Computer Engineering will be offered at least once a year at the end of the spring semester.

**Electrical Engineering**
(For students matriculating after 8/1/2014)
Students must demonstrate competency in one of the following areas within electrical engineering in which the electrical engineering faculty have established research thrust areas:

1. Circuits and Instrumentation
2. Robotics
3. Micro- and Nano-systems

To demonstrate competency in one of these areas, the student must do one of the following: (1) take the course for that area and pass that course with a grade of A, or (2) pass a written exam for that specific area. The designated courses for each of the areas are:

1. Circuits and Instrumentation: EECS 426 MOS Integrated Circuit Design
2. Robotics: EECS 489 Robotics I

In the event that a designated course is not offered within a reasonable period of time, the student may petition the faculty in electrical engineering to designate a suitable substitute.

A student failing to meet the requirements proscribed above may, with the support of his/her dissertation research advisor, petition the faculty for an oral exam. The oral exam will consist of a 30 minute presentation by the student to a 3-member examination committee made up of electrical engineering faculty. The topic will be drawn from the student’s area of interest as selected by his/her advisor and approved by the committee. The topic may not come directly from the student’s MS thesis conducted at CWRU or elsewhere.

A student has completed the Ph.D. Qualifier in electrical engineering when: (1) he/she has successfully completed the aforementioned competency requirement, (2) a group of faculty within his/her selected research area has conducted a review of the student’s academic record and determined that adequate progress has been made, and (3) the student has formally identified a dissertation advisor.

(For students matriculating prior to 8/1/2014)
The written portion of the PhD Qualifier in Electrical Engineering is designed to assess a student’s knowledge and understanding of topics fundamental to all electrical engineering students pursuing a doctorate in the field. The written exam will consist of questions at the advanced undergraduate level covering material from the three topic areas listed below. Courses currently in the EE undergraduate curriculum corresponding to a particular topic area are listed in parentheses.

1. EECS 309 Electromagnetic Fields I
2. EECS 245 Electronic Circuits, EECS 281 Logic Design and Computer Organization
3. EECS 246 Signals and Systems

Exam problems will be limited to materials contained in the selected references as well as the aforementioned courses. Sample problems from previous exams as well as a list of relevant references are available upon request.

Students must show competency in all three tested areas. Upon recommendation of the faculty, a student showing marginal proficiency in one area may be required to correct this deficiency, for example, by
taking an appropriate course (as determined by the faculty) and pass this course with at least a B grade or by serving as a teaching assistant of an appropriate course.

The written part of the Qualifying Exam for Electrical Engineering will be offered at least once a year during the month of January, prior to the beginning of the spring semester.

**Systems and Control Engineering**
Students must show competency in control systems engineering, signals and systems, and systems analysis (optimization, simulation, stochastic modeling, and decision and economic analysis). Students must demonstrate proficiency in at least three of the following areas:

1. Control Systems (EECS 408 Introduction to Linear Systems, EECS 304 Control Engineering I with Laboratory)
2. Optimization (EECS 416 Convex Optimization for Engineering, EECS 346 Engineering Optimization)
4. Simulation and Discrete Event Systems (EECS 324 Modeling and Simulation of Continuous Dynamical Systems)
5. Stochastic Models and Decisions (EECS 352 Engineering Economics and Decision Analysis, EECS 452 Random Signals)

To demonstrate proficiency in an area, the student can either take one of the courses listed for that area and obtain a course grade of A or take and pass an exam for that specific area. Upon recommendation by the faculty, the student showing marginal proficiency in any area may be required to improve proficiency by serving as a teaching assistant of an appropriate course.

**Part 2**
The second part of the Ph.D. Qualifier shall be prepared and administered by the designated Ph.D. Qualifying committee for students in the Electrical Engineering program and in the Computer Engineering program or by the student’s Ph.D. dissertation guidance committee for each Ph.D. student in the Systems and Control program. This exam will test the student on advanced topics in the student’s major area of study as well as specialized topics relevant to the student’s research area.

**Computer Engineering**
Part 2 will consist of an oral exam based on the areas of the written examination. However, the oral maybe waived if the student has performed well in all three topic areas of the written exam.

**Electrical Engineering**
(For students matriculating after 8/1/2014)

Does not apply
(For students matriculating prior to 8/1/2014)

Only those students performing adequately on the written exam will advance to the oral portion of the qualifier. The exam will be administered by a three-member examination committee assembled from the ECSE faculty. The oral portion of the PhD Qualifier will consist of a two-part examination. The first part of the oral exam will consist of a 20 minute presentation by the student on a topic selected by the examination committee. The topic will be one that is well documented in the scientific/engineering literature. In selecting the topic, the examination committee will take into account the student’s research interests, academic background and experience in the field. The student will be given the topic 15 working days prior to the examination. The topic will be presented to the student in the form of a published paper or collection of papers. The student will be required to demonstrate competency in the following areas: (1) the material directly covered by the paper(s), (2) the material covered in the important references in the paper(s), and (3) any relevant background material that is necessary for the fundamental understanding of the paper.

The second part of the oral exam will consist of a series of questions drawn from the topic areas covered by the written exam.

As with the written exam, a student showing marginal proficiency during the oral exam may be asked to perform some sort of remediation at the discretion of the oral examination committee.

**Systems and Control Engineering**
A typical exam begins with a selection by the student’s dissertation guidance committee of 5-6 research articles relevant to the student’s research area. The students will be given 4 weeks to write a report answering questions formulated from those papers by the dissertation guidance committee. This will be followed within one week by an oral exam during which the student will give an oral presentation based on the report and answer questions from the dissertation guidance committee and other attending EECS faculty. Questions will be based on the report as well as miscellaneous questions on advanced topics in Systems and Control as deemed appropriate by committee members and/or other attending faculty.

**Ph.D. Candidacy**
The final consideration of whether to admit the student to Ph.D. candidacy will be taken by the Ph.D. Qualifying Committee (for Electrical Engineering and Computer Engineering students) or the student’s dissertation guidance committee (for Systems and Control students) after the student has passed the Ph.D. Qualifier. A written report on the results of the qualifier and Ph.D. candidacy will be prepared by the committee and submitted to the Department Chairperson, who, in turn, will notify the School of Graduate Studies of the results.

**Ph.D. Proposal**
After passing the Qualifier and being admitted to Ph.D. candidacy, the Ph.D. candidate is required to pass a Dissertation Proposal Exam on a timely basis, generally within one semester after being admitted to candidacy. This exam shall be administered by the student’s dissertation guidance committee and consists of a written dissertation proposal and an oral presentation of the proposed dissertation research. As part of the oral presentation, the student will be expected to answer questions covering the proposed research as well as questions on related topics as deemed appropriate by the student’s dissertation guidance committee. The written dissertation proposal must be received by the committee members at least ten days before the date scheduled for the oral exam and presentation. The Dissertation Proposal Exam, the Ph.D. research, the final oral dissertation defense, and all other requirements in the student’s Ph.D. program of study must be completed within five years after the student is admitted to Ph.D. candidacy.

**The Ph.D. Oral Defense**
The student shall provide an announcement containing a title, abstract, date, time and location of the defense to the EECS Office of Student Affairs for general distribution at least 10 days in advance of the thesis defense.

**The Ph.D. Residency Requirements**
All Ph.D. students shall fulfill the Ph.D. residency requirements set forth by the Case School of Engineering and the School of Graduate Studies. Specifically, the Ph.D. student is required either to register for at least
9 credit hours during each of two consecutive semesters or to engage in academic work (taking courses, assisting in course development and/or teaching, fully engaging in research, or some other scholarly activities) in at least six consecutive terms (fall, spring, or summer) between matriculation and a period not exceeding 5 years after the first credited hour of EECS 701. The period during a leave of absence cannot be counted to fulfill the residency requirement.

**Appeals**

Any decision by an academic advisor, dissertation guidance committee, or Department Associate Chairperson may be appealed, in writing, to the Department Associate Chairperson who shall present the appeal, with his recommendations, to the faculty at its next regular faculty meeting. The faculty’s decision shall be final.

**Other Regulations**

All students pursuing graduate studies in the Electrical Engineering and Computer Science department must abide by the academic regulations of the School of Graduate Studies and the Case School of Engineering contained in the most recent issue of the General Catalog of Case Western Reserve University, and supplemented by the Department of Electrical Engineering and Computer Science regulations.

**NOTE:** The above regulations apply to graduate students who entered the degree programs in computer engineering, electrical engineering, and systems & control engineering after January 1, 2005.

**Ph.D. Degree Program (Computer and Information Science)**

**Ph.D. Requirements**

Each student must satisfy requirements in the following categories:

- Course Work
- Mathematics and Science Requirement
- Research Proposal
- Qualifying Examination
- Dissertation

All programs of study must contain at least 36 hours of courses past the undergraduate degree. All courses must be at the 400-level or higher. Two of the courses must be in a basic science or mathematics. A minimum of 12 hours must be in courses outside the student’s thesis area. A student must have attained a minimum 3.25 grade point average (GPA) at the time of graduation. The minimum GPA is calculated based on all courses in the student's Program of Study that carry quality points.

These regulations are in addition to the Academics Regulations of the School of Graduate Studies and the Specific Requirements for the Ph.D. Degree of the Graduate Program in the Case School of Engineering as found in the General Bulletin of Case Western Reserve University.

When applying to this program, please select the CIS (Computing and Information Sciences) option in your application.

**Academic Advisor and Research Advisor**

Upon arrival each graduate student is assigned an academic advisor from the Computer Science (CS) program faculty, typically the CS graduate representative. By the end of the second semester of study, a Ph.D. student should transfer to a research advisor who may or may not be the same as the academic advisor. Once a research advisor is selected, the research advisor will also serve as the academic advisor, with whom a student consults to ensure that the balance of the Ph.D. course work constitutes a coherent program of study.

If the research advisor is not from the Computer Science program, the student must have an academic advisor from the CS program. The academic advisor may serve as a research co-advisor, if so desired by the student and the research advisor.

**Program of Study**

Each Ph.D. student must submit a Program of Study detailing his or her course work, Qualifying Examination and dissertation schedules. The Program of Study lists all courses taken beyond the undergraduate degree and shows how these courses satisfy the following course requirements for the Ph.D.:

1. The minimum course requirement beyond the B. S. level is 36 credit hours of courses taken for credit, at least 18 hours of which must be taken at CWRU. The following courses taken for credit will be acceptable:
   - All 400, 500, 600 level courses.
   - Graduate level courses taken at other institutions approved by the student’s advisor.

   The above courses must include the following:

   1.1 A minimum of 12 credit hours in the student's dissertation research area.
   1.2 A minimum of 6 credit hours in mathematics or basic science.
   1.3 A minimum of 12 credit hours of breadth courses that are not in the student's dissertation research area. The courses for items 1.1, 1.2, and 1.3 must be disjoint.
   1.4 A minimum of 18 credit hours of courses approved by the Computer Science program which can be courses used in item 1.1 and item 1.3. These approved Computer Science courses are listed below.

2. A minimum of 18 credit hours of EECS 701 Dissertation Ph.D..

3. The cumulative grade-point average of all CWRU courses on the program of study must be at least 3.25.

4. All Ph.D. students are required to register for and pass EECS 400T Graduate Teaching I, EECS 500T Graduate Teaching II and EECS 600T Graduate Teaching III which are 0 credit hour courses that provide students with teaching experience.

5. All Ph.D. students are required to register for and pass three semesters of “EECS 500 EECS Colloquium” (a 0 credit hour course) before advancement to candidacy and complete a public presentation of their work.

The Program of Study must be approved by the student's academic advisor and the chair of the EECS Department, and it must be approved before the student advances to candidacy.

**Qualifying Examination**

The Computer Science Ph.D. qualifying examination is in the form of an oral exam and a written report, assessing the student's ability to survey a specific research topic, discuss the state-of-the-art in depth, provide a critical description of the literature, and propose creative ideas on improving the state-of-the-art. The written and oral parts of the exam are administered by a committee consisting of three faculty members. The exam is supplemented by the evaluation of the student's course
performance and the final decision is made in a meeting of faculty affiliated with the CS program.

Students who hold an M.S. degree are required to take the qualifying exam at the start of their 3rd semester, and pass the qualifying exam before the start of their 4th semester in the Ph.D. program. Students who do not hold an M.S. degree are required to take the qualifying exam at the start of their 5th semester, and pass the qualifying exam before the start of their 6th semester in the Ph.D. program.

Committee: The exam will be administered by a committee composed of 3 faculty members, at least 2 of them being faculty members whose primary affiliation is Computer Science. The student will provide 0 to 3 names as suggested committee members and the CS Graduate Committee will appoint the committee, taking into account the student's suggestion and maintenance of the load balance of the faculty. If the student has a research advisor at the time of the exam, then the advisor must be a member of the committee, but cannot serve as the chair of the committee. The CS Graduate Committee will make every effort to include a faculty member outside the research area in the committee. The committee must be appointed at least 2 months prior to the exam.

Format: The student will select a research area from the following list:

1. Algorithms
2. Artificial Intelligence
3. Biomedical informatics
4. Computer Networks and Distributed Systems
5. Databases and Data Mining
6. Software Engineering

The exam committee will ask the student to write a report that adequately demonstrates the student’s ability to perform research in their chosen area of research. Specific examples of this might be a survey of a broad area and/or approaches to a specific problem in the area. This will be followed by an oral examination.

Written Report: The student will submit a written report on the specific research problem. The report has to adequately describe the problem and justify its relevance, identify the challenges associated with the problem, provide a broad classification of existing approaches, point out their key differences and trade-offs, identify limitations, and propose solutions for these limitations. The report must be at most 10 pages in length (11 pt font, single-spaced, single column, 1” margins) and use illustrative figures, tables, and other visual material to communicate key ideas. In addition, the report must include a comprehensive list of references. The written report must be submitted to the exam committee three weeks before the date of the oral exam.

Oral Exam: In the oral exam, the student will answer questions by the committee members on a specific research problem chosen by the committee in the selected research area, assessing the knowledge, technical depth, and broader vision of the student on the problem. The committee may also ask questions on the fundamentals of computer science as they relate to the specific research problem. The student may prepare slides in advance that will help answer questions or use the chalk board (or both), but the exam will not be in the format of a presentation. The exam will be one hour in duration. All students who are taking the exam for the first time have to take their oral exam in the week prior to the beginning or in the first two weeks of the Fall semester.

Scoring: Each of the three committee members will prepare a report rating the student’s exam performance according to the following criteria:

- Fundamentals: Does the student have broad knowledge of fundamental concepts in computer science that will enable the student to understand and tackle the challenges in the specific research area?
- Knowledge of Chosen Area: Does the student have sufficient technical depth and command of the key challenges and the state-of-the-art in the chosen area of research?
- Vision: Does the student demonstrate a solid understanding of the relevance of the problem in the context of scientific progress and societal needs? Does the student show creativity in innovating their chosen area of research?
- Communication: Can the student explain the concepts in an accessible and comprehensible manner and handle questions effectively?
- Overall Score for the Written Report and the Oral Exam.

Possible ratings are 2 (Pass), 1 (Retake), or 0 (Fail).

Course Work: The student’s performance in all courses taken before the exam will also be considered by the CS program faculty in making a decision. At the time of the exam, the student must have completed at least two 400-level Computer Science courses with a "B" or above. One of these courses must be EECs 454 Analysis of Algorithms or EECs 477 Advanced Algorithms. The second course must be relevant to their chosen area of research. The relevance of the additional course to the research area is subject to approval by the CS Graduate Studies Committee. The following courses are pre-approved for each area:

3. Biomedical Informatics: EECs 458 Introduction to Bioinformatics, EECs 459 Bioinformatics for Systems Biology
5. Databases and Data Mining: EECs 405 Data Structures and File Management, EECs 433 Database Systems, EECs 435 Data Mining

Outcome: The final decision will be made by the CS program faculty based on the committee’s reports and the student’s coursework. The outcome of the exam will be one of Pass (the student advances to candidacy), Retake (the student has to retake the exam once more before the end of the following semester. The Retake decision can be partial, i.e. the student may be asked to retake the oral exam only, rewrite the report only, or take/retake a course), Fail (the student will be separated from the PhD program). The decision will be documented by the CS graduate chair and the student will be sent a notification letter.

Advancement to Candidacy
A student formally advances to candidacy after passing the Qualifying Examination and finding a faculty member who agrees to be the student’s
research advisor. The student should advance to candidacy within one semester of passing the Qualifying Examination.

Students should submit documentation, approved by the academic and research advisor(s), to the Chairman of the Graduate Studies Committee of Computer Science to be admitted to candidacy.

Students who have failed to complete the conditions above within the time limit will be separated from the Ph.D. program. Separation may also occur in the event of failure of the student to maintain a satisfactory GPA. A student who has been separated may not undertake further study for credit toward the Ph.D. degree. With the approval of the Department and the Dean of Graduate Studies, such a student may complete a master's degree, may register as a non-degree student or seek admission to the graduate program of another department.

**Dissertation Advisory Committee**
Each Ph.D. student must form a Dissertation Advisory Committee which consists of at least 4 members of University faculty. The student’s academic advisor serves as the chair of this committee. Both the chair of the committee and at least one other member must be a regular faculty member whose primary affiliation is with the Computer Science program. The committee must also include one member whose primary appointment is not in the Computer Science program.

**Dissertation Proposal**
The Ph.D. student must write a formal thesis proposal and defend it in an oral presentation to his or her Dissertation Advisory Committee. Normally this is done within a year of advancing to candidacy. A student who fails to defend his or her thesis proposal can attempt to defend it a second time after modifying the thesis proposal, but a second failure will cause the student to be separated from the program.

**Dissertation**
The student’s dissertation must be original research in CS which represents a significant contribution to existing knowledge in the student’s research area, a portion of which must be suitable for publication in reputable research journals or selective peer-reviewed conferences. In addition to the written dissertation, the doctoral candidate must pass an oral examination in defense of the dissertation. The Dissertation Advisory Committee is responsible for certifying that the quality and suitability of the material presented in the dissertation meet acceptable scholarly standards. To satisfy requirement 5 of the Program of Study above, if the student has not publicly presented their work at a conference or similar external venue, they must also present the dissertation research in a departmental seminar.

**Course List for Program of Study Requirement**

EECS 405 Data Structures and File Management
EECS 425 Computer Networks I
EECS 433 Database Systems
EECS 435 Data Mining
EECS 439 Web Data Mining
EECS 440 Machine Learning
EECS 441 Internet Applications
EECS 442 Causal Learning from Data
EECS 444 Computer Security
EECS 454 Analysis of Algorithms
EECS 458 Introduction to Bioinformatics
EECS 459 Bioinformatics for Systems Biology
EECS 466 Computer Graphics
EECS 477 Advanced Algorithms
EECS 484 Computational Intelligence I: Basic Principles
EECS 491 Artificial Intelligence: Basic Principles
EECS 493 Software Engineering
EECS 496 Artificial Intelligence: Sequential Decision Making
EECS 497 Artificial Intelligence: Statistical Natural Language Processing
EECS 499 Algorithmic Robotics
EECS 531 Computer Vision

**EECS Colloquium and Presentation Requirement Ph.D. Students**
The requirement has two parts: (1) passing 3 semesters of EECS 500 EECS Colloquium, and (2) a public presentation.

(1) All Ph.D. students are required to register for and pass EECS 500 Electrical Engineering and Computer Science Colloquium for a total of three semesters of the Ph.D. Program, and this is expected before Advancement to Candidacy. (This is a 0 credit hour required course.) Students (such as students working in industry) may propose an alternative arrangement for fulfilling this requirement, by submitting a written petition to the Graduate Studies Committee.

(2) All Ph.D. students must give a public presentation of their research, in addition to their Ph.D. dissertation defense. This presentation must be given either at a research conference or in the EECS seminar series.

**Graduate Certificates**
Graduate Certificates are discipline independent and intended to enable knowledgeable entry into the field of study. They are prescribed 3-course, 9-credit subsets of our MS degree offerings.

**Wearable Computing**

**Required Courses**

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>EECS 480T</td>
<td>Wearable Computing Design</td>
<td>3</td>
</tr>
<tr>
<td>EECS 480U</td>
<td>Wearable Computing Technology</td>
<td>3</td>
</tr>
<tr>
<td>EECS 480W</td>
<td>Wearable Computing Manufacturing</td>
<td>3</td>
</tr>
</tbody>
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**Wireless Health**

**Required Courses**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBME/EECS 480A</td>
<td>Introduction to Wireless Health</td>
<td>3</td>
</tr>
<tr>
<td>EBME/EECS 480B</td>
<td>The Human Body</td>
<td>3</td>
</tr>
<tr>
<td>EBME/EECS 480C</td>
<td>Biomedical Sensing Instrumentation</td>
<td>3</td>
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For more details, please refer to the Graduate Certificate (http://engineering.case.edu/sandiego/gc) information on the Case School of Engineering - San Diego website.
Facilities

Computer Facilities

The department computer facilities incorporate both Unix (primarily Solaris) and Microsoft Windows-based operating systems on high end computing workstations for education and research. A number of file, printing, database, and authentication servers support these workstations, as well as the administrative functions of the department. Labs are primarily located in the Olin and Glennan buildings, but include Nord Hall, and are networked via the Case network.

The Case network is a state-of-the-art, high-speed fiber optic campus-wide computer network that interconnects laboratories, faculty and student offices, classrooms, and student residence halls. It is one of the largest fiber-to-desktop networks anywhere in the world. Every desktop has a 1 Gbps (gigabit per second) connection to a fault-tolerant 10 Gbps backbone. To complement the wired network, over 1,200 wireless access points (WAPs) are also deployed allowing anyone with a laptop or wireless enabled PDA to access resources from practically anywhere on campus.

Off campus users, through the use of virtual private network (VPN) servers, can use their broadband connections to access many on campus resources, as well as software, as if they were physically connected to the Case network. The department and the university participate in the Internet2 and National Lambda Rail projects, which provides high-speed, inter-university network infrastructure allowing for enhanced collaboration between institutions. The Internet2 infrastructure allows students, faculty and staff alike the ability to enjoy extremely high performance connections to other Internet2 member institutions.

Aside from services provided through a commodity Internet connection, Case network users can take advantage of numerous online databases such as EUCLIDplus, the University Libraries’ circulation and public access catalog, as well as Lexus-Nexis™ and various CD-ROM based dictionaries, thesauri, encyclopedias, and research databases. Many regional and national institutional library catalogs are accessible over the network, as well.

EECS faculty are active users of the Microfabrication Laboratory and participants in the Advanced Platform Technology Center described under Interdisciplinary Research Centers.

Additional Department Facilities

Sally & Larry Sears Undergraduate Design Laboratory

This laboratory supports all departmental courses in circuits and includes a state-of-the-art lecture hall, a modernistic glass-walled lab, an electronics “store”, and a student lounge and meeting area. Specialized lab space is available for senior projects and sponsored undergraduate programs. The lab is open to all undergraduates, and components are provided free of charge, so students can “play and tinker” with electronics and foster innovation and creativity. The laboratory provides access to PCs, oscilloscopes, signal generators, logic analyzers, and specialized equipment such as RF analyzers and generators. In addition, the lab includes full-time staff dedicated to the education, guidance and mentoring of undergraduates in the “art and practice” of hands-on engineering.

This is the central educational resource for students taking analog, digital, and mixed-signal courses in electronics, and has been supported by various corporations in addition to alumnus Larry Sears, a successful engineer and entrepreneur. Basic workstations consist of Windows-based computers equipped with LabView software, as well as Agilent 546xx oscilloscopes, 33120A Waveform Generators, 34401A Digital Multimeters, and E3631A power supplies. Advanced workstations are similarly configured, but with a wider variety of high-performance test equipment.

Jennings Computer Center Lab

Supported by an endowment from the Jennings Foundation, this lab provides our students with the educational resources necessary for their classroom and exploration of the art of computing. This lab has both PCs and Sun Unix workstations, and includes two high-speed laser printers.

EECS Undergraduate Computer Lab

This laboratory (recently renovated with major funding provided by Rockwell Automation) on the 8th floor of the Olin building is accompanied by a suite of instructor/TA offices, and supports the freshman computing classes: ENGR 131 Elementary Computer Programming and EECS 132 Introduction to Programming in Java. Thirty student Macintosh workstations with underlying UNIX operating systems are available for hands-on instruction, and support the study of introductory programming at the university.

Nord Computer Laboratory

This is a general-purpose computer facility that is open 24 hours a day, to all students. The lab contains 50 PCs running Windows and four Apple Macintosh computers. Facilities for color printing, faxing, copying and scanning are provided. Special software includes PRO/Engineer, ChemCAD and Visual Studio. Blank CDs, floppy disks, transparencies and other supplies are available for purchase. Visit the website (http://www.scl.cwru.edu) for more information.

Virtual Worlds (Gaming and Simulation) Laboratory

The Virtual Worlds Gaming and Simulation Lab forms the basis for experiential work in existing game related courses such as Artificial Intelligence, Graphics, and Simulation and for new gaming/simulation courses. Multi-disciplinary senior projects also use the lab facilities. In addition, a large number of significant cross-disciplinary immersive learning opportunities are available with the Cleveland Institute of Art, the CWRU Music department, and the CWRU School of Medicine.

The Virtual Worlds laboratory includes a PC room, a Console room, an Immersion room, an Audio room, a Medical Simulation room, and a Virtual Reality room containing:

- 24 networked high-performance Alienware gaming quality PCs
- Virtual reality components including three head mounted displays, three data gloves, a four sensor magnetic tracker, two inertial trackers, and three haptic interfaces
- Game consoles, e.g. PS2, Xbox, Gamecube, Nintendo DS, PSP
- Large screen 2-D and 3-D projection displays
- Audio and music synthesis and production equipment

Database and Bioinformatics Research Laboratory

Primarily funded by equipment grants from the National Science Foundation and Microsoft Research, this laboratory provides PCs running Windows and Linux supporting research in database systems and bioinformatics.

Networks Laboratory

Supported through donations from both Cisco Systems and Microsoft Research, the networks lab has 15 stations complete with a PC, a Cisco switch and router, IP telephony equipment, as well as network patches
Intelligent Networks & Systems Architecting (INSA) Research Laboratory

The Intelligent Networks & Systems Architecting (INSA) Research Laboratory is a state-of-the-art research facility dedicated to intelligent computer networks, systems engineering, design, and architecture. It includes optimization, simulation, artificial intelligence, visualization, and emulation. This lab has been partially supported by NASA’s Space Exploration programs for Human and Robotic Technology (H&R&T). The INSA Lab is equipped with 10 high-performance workstations and 2 servers in a mixed Windows and Linux environment, with over 40 installed network interface cards providing connectivity to its wired and wireless research networks. It includes software packages such as GINO and LINDO, Arena simulation, ns2 and OPNET, as well as the STK satellite toolkit, artificial neural network, systems architecture and modeling, and statistical analysis and data management packages such as SPSS. The INSA Lab is also used for research in heterogeneous, sensor web, and mobile ad-hoc networks with space and battlefield applications.

Embedded Systems Laboratory

The Embedded Systems Laboratory is equipped with several Sun Blade Workstations running Solaris and Intel PCs running Linux. This lab has been recently equipped with advanced FPGA Virtex II prototype boards from Xilinx, including about 100 Xilinx Virtex II FPGAs and Xilinx CAD tools for development work. A grant-in-aid from Synopsys has provided the Synopsys commercial CAD tools for software development and simulation. This Lab is also equipped with NIOS FPGA boards from Altera, including software tools.

Mixed-Signal Integrated Circuit Laboratory

This research laboratory includes a cluster of Windows workstations and a UNIX server with integrated circuit design software (Cadence Custom IC Bundle), as well as a variety of equipment used in the characterization of mixed-signal (analog and digital) integrated circuits, which are typically fabricated using the MOSIS foundry service. Test equipment includes an IC probe station, surface-mount soldering equipment, logic and network/spectrum analyzers, an assortment of digital oscilloscopes with sample rates up to 1 GHz, and a variety of function generators, multi-meters, and power supplies.

Microelectromechanical Systems (MEMS) Research Laboratory

The MEMS Research Laboratory is equipped for microfabrication processes that do not require a clean room environment. These include chemical-mechanical polishing (two systems), bulk silicon etching, aqueous chemical release of free standing micromechanical components, and supercritical point drying. In addition to the fabrication capabilities, the lab is also well equipped for testing and evaluation of MEMS components as it houses wafer-scale probe stations, a vacuum probe station, a multipurpose vacuum chamber, and an interferometric load-deflection station. Two large (8 x 2 ft2) vibration isolated air tables are available for custom testing setups. The laboratory has a wide variety of electronic testing instruments, including a complete IV-CV testing setup.

BioMicroSystems Laboratory

This research laboratory focuses on developing wireless integrated circuits and microsystems for a variety of applications in biomedical and neural engineering. The laboratory contains several PC computers, software packages for design, simulation, and layout of high-performance, low-noise, analog/mixed-signal/RF circuits and systems, and testing/measurement equipment such as dc power supply, arbitrary function generator, multichannel mixed-signal oscilloscope, data acquisition hardware, spectrum analyzer, potentiostat, and current source meter. Visit the website (http://www.mohsenilab-cwru.org) for more information.

Emerging Materials Development and Evaluation Laboratory

The EMDE Laboratory is equipped with tooling useful in characterizing materials for MEMS applications. The laboratory contains a PC-based apparatus for load-deflection and burst testing of micromachined membranes, a custom-built test chamber for evaluation and reliability testing of MEMS-based pressure transducers and other membrane-based devices, a probe station for electrical characterization of micro-devices, a fume hood configured for wet chemical etching of Si, polymers, and a wide variety of metals, tooling for electroplating, an optical reflectometer, and a supercritical-point dryer for release of surface micromachined devices. The lab also has a PC with layout and finite element modeling software for device design, fabrication process design and analysis of testing data.

Laboratory for Nanoscale Devices and Integrated Systems

This research lab explores new engineering and physics at the nanoscale, and by applying such knowledge, develops new devices and tools for emerging technological applications in the new frontiers of information, biomedical, and life sciences. A primary current theme of the research is on developing nanoscale electromechanical systems (NEMS), based on exploration and understandings of mesoscopic devices fundamentals and new characteristics of various nanoscale structures and functional systems. The lab has been developing NEMS with new functions and high performance, in combination with some of the latest advances in advanced materials, integrated circuits, and others, through crossdisciplinary explorations and collaboration. The lab is dedicated to the development of various NEMS transducers, biosensors, high-frequency nanodevices, and high-precision instruments. For more information, contact Dr. Philip Feng (philip.feng@case.edu).

Some of the recent research highlights include: the first very-high-frequency silicon nanowire resonators and sensors, the first ultra-high-frequency self-sustaining oscillators (aka NEMS clocks), and the first low-voltage (~1V), high-speed nanowire NEMS switches, and the first NEMS mass sensors for weighing single-biomolecules and for probing the noise arising from adsorbed atoms walking on the surface of a vibrating NEMS.

Control and Energy Systems Center (CESC)

The Control and Energy Systems Center (CESC) looks for new transformational research and engineering breakthroughs to build a better world, improving our industry, economy, energy, environment, water resources and society, all with sustainability and within an international collaboration framework. With an interdisciplinary and concurrent
DSCI 234. Structured and Unstructured Data. 3 Units.
This course is an introduction to types of data and their representation, storage, processing and analysis. The course has three parts. In the first part of the course, students will develop a basic understanding and the ability to represent, store, process and analyze structured data. Structured data include catalogs, records, tables, logs, etc., with a fixed dimension and well-defined meaning for each data point. Suitable representation and storage mechanisms include lists and arrays. Relevant techniques include keys, hashes, stacks, queues and trees. In the second part of the course, students will develop a basic understanding and the ability to represent, store, process and analyze semi-structured data. Semi-structured data include texts, web pages and networks, without a dimension and structure, but with well-defined meaning for each data point. Suitable representation and storage mechanisms include trees, graphs and RDF triples. Relevant techniques include XML, YAML, JSON, parsing, annotation, language processing. In the third part of the course, students will develop a basic understanding and the ability to represent, store, process and analyze unstructured data. Unstructured data include images, video, and time series data, without neither a fixed dimension and structure, nor well-defined meaning for individual data points. Suitable representation and storage mechanisms include large matrices, EDF, DICOM. Relevant techniques include feature extraction, segmentation, clustering, rendering, indexing, and visualization. Prereq: DSCI 133.

DSCI 341. Introduction to Databases: DS Major. 3 Units.
Database management become a central component of a modern computing environment, and, as a result, knowledge about database systems has become an essential part of education in computer science and data science. This course is an introduction to the nature and purpose of database systems, fundamental concepts for designing, implementing and querying a database and database architectures. Weeks 1-6 provide an overview of basic database systems concepts including database design, database systems architecture, and database querying, using relational model and SQL as query language. Weeks 7-10 Objects, Semi structured data, XML and RDF basics. Weeks 11-14 provide an overview of more advanced topics including Database System Architectures (Parallel Databases and Distributed Databases), and Data Warehousing and Information Retrieval. Prereq: DSCI 234 or EECS 233.

DSCI 342. Introduction to Data Science Systems. 3 Units.
An introduction to the software and hardware architecture of data science systems, with an emphasis on Operating Systems and Computer Architecture that are relevant to Data Sciences systems. At the end of the course, the student should understand the principles and architecture of storage systems, file systems (especially, HDFS), memory hierarchy, and GPU. The student should have carried out projects in these areas, and should be able to critically compare various design decisions in terms of capability and performance. Prereq: DSCI 234.

DSCI 343. Introduction to Data Analysis. 3 Units.
In this class we will give a broad overview of data analysis techniques, covering techniques from data mining, machine learning and signal processing. Students will also learn about probabilistic representations, how to conduct an empirical study and support empirical hypotheses through statistical tests, and visualize the results. Course objectives: -Expose students to different analysis approaches. -Understand probabilistic representations and inference mechanisms. -Understand how to create empirical hypotheses and how to test them. Prereq: EECS 340 and DSCI 234.
DSCI 344. Scalable Parallel Data Analysis. 3 Units.
This course provides an introduction to scalable and parallel data analysis using the most common frameworks and programming tools in the age of big data. Covered topics include parallel programming models, parallel hardware architectures, multi-threaded, multi-core programming, cluster computing and GPU programming. The course is designed to provide a heavily hands-on experience with several programming assignments. Prereq: DSCI 342.

DSCI 345. Files, Indexes and Access Structures for Big Data. 3 Units.
Database management become a central component of a modern computing environment, and, as a result, knowledge about database systems has become an essential part of education in computer science and data science. This course is an introduction to the nature and purpose of database systems, fundamental concepts for designing, implementing and querying a database and database architectures. Objectives: -An expert knowledge of basic data structures, basic searching, sorting, methods, algorithm techniques, (such as greedy and divide and conquer) -In-depth knowledge on Search and Index Structures for large, heterogeneous data including multidimensional data, high dimensional data and data in metric spaces (e.g., sequences, images), on different search methods (e.g. similarity searching, partial match, exact match), and on dimensionality reduction techniques. Prereq: DSCI 234 or EECS 233.

DSCI 390. Machine Learning for Big Data. 3 Units.
Machine learning is a sub-field of Artificial Intelligence that is concerned with the design and analysis of algorithms that “learn” and improve with experience. While the broad aim behind research in this area is to build systems that can simulate or even improve on certain aspects of human intelligence, algorithms developed in this area have become very useful in analyzing and predicting the behavior of complex systems. Machine learning algorithms have been used to guide diagnostic systems in medicine, recommend interesting products to customers in e-commerce, play games at human championship levels, and solve many other very complex problems. This course is an introduction to algorithms for machine learning and their implementation in the context of big data. We will study different learning settings, the different algorithms that have been developed for these settings, and learn about how to implement these algorithms and evaluate their behavior in practice. We will also discuss dealing with noise, missing values, scalability properties and talk about tools and libraries available for these methods. At the end of the course, you should be able to: --Understand when to use machine learning algorithms; --Understand, represent and formulate the learning problem; --Apply the appropriate algorithm(s) or tools, with an understanding of the tradeoffs involved including scalability and robustness; --Correctly evaluate the behavior of the algorithm when solving the problem. Prereq: DSCI 234 and DSCI 343.

DSCI 391. Data Mining for Big Data. 3 Units.
With the unprecedented rate at which data is being collected today in almost all fields of human endeavor, there is an emerging economic and scientific need to extract useful information from it. Data mining is the process of automatic discovery of patterns, changes, associations and anomalies in massive databases, and is a highly interdisciplinary field representing the confluence of several disciplines, including database systems, data warehousing, machine learning, statistics, algorithms, data visualization, and high-performance computing. This course is an introduction to the commonly used data mining techniques. In the first part of the course, students will develop a basic understanding of the basic concepts in data mining such as frequent pattern mining, association rule mining, basic techniques for data preprocessing such as normalization, regression, and classic matrix decomposition methods such as SVD, LU, and QR decompositions. In the second part of the course, students will develop a basic understanding of classification and clustering and be able to apply classic methods such as k-means, hierarchical clustering methods, nearest neighbor methods, association based classifiers. In the third part of the course, students will have a chance to study more advanced data mining applications such as feature selection in high-dimensional data, dimension reduction, and mining biological datasets. Prereq: DSCI 234 and DSCI 343.

EECS 132. Introduction to Programming in Java. 3 Units.
Introduction to computer programming and problem solving with the Java language. Computers, operating systems, and Java applications; software development; conditional statements; loops; methods; arrays; classes and objects; object-oriented design; unit testing; strings and text I/O; inheritance and polymorphism; GUI components; application testing; abstract classes and interfaces; exception handling; files and streams; GUI event handling; generics; collections; threads; comparison of Java to C, C++, and C#.

EECS 216. Fundamental System Concepts. 3 Units.
Develops framework for addressing problems in science and engineering that require an integrated, interdisciplinary approach, including the effective management of complexity and uncertainty. Introduces fundamental system concepts in an integrated framework. Properties and behavior of phenomena regardless of the physical implementation through a focus on the structure and logic of information flow. Systematic problem solving methodology using systems concepts. Recommended preparation: MATH 224.

EECS 233. Introduction to Data Structures. 4 Units.
The programming language Java; pointers, files, and recursion. Representation and manipulation of data: one way and circular linked lists, doubly linked lists; the available space list. Different representations of stacks and queues. Representation of binary trees, trees and graphs. Hashing; searching and sorting. Prereq: EECS 132.

EECS 245. Electronic Circuits. 4 Units.
EECS 246. Signals and Systems. 4 Units.

EECS 275. Fundamentals of Robotics. 4 Units.
The Fundamentals of Robotics course will expose students to fundamental principles of robotics. Students will explore high level conceptual foundations of robotics beginning with Braitenberg vehicles and apply this knowledge to simulated and physical robot hardware in laboratory experiences and in a final project. Laboratory experiences will guide students through applying theory to practice increasingly complex tasks in a project oriented, group work environment. The course culminates in a robotics challenge project at the end of the semester. Topics covered are: sensors, actuators, kinematics, control, planning and programming. Programming languages and concepts (e.g., C++, object oriented programming) used in robotics will be introduced and used with modern robotics programming toolboxes and frameworks. Prior experience with these languages will not be necessary. Previous experience with robotics is not required for this course. Prereq: (ENGR 131 or EECS 132) and PHYS 121 and MATH 121.

EECS 281. Logic Design and Computer Organization. 4 Units.
Fundamentals of digital systems in terms of both computer organization and logic level design. Organization of digital computers; information representation; boolean algebra; analysis and synthesis of combinational and sequential circuits; datapaths and register transfers; instruction sets and assembly language; input/output and communication; memory. Prereq: ENGR 131 or EECS 132.

EECS 290. Introduction to Computer Game Design and Implementation. 3 Units.
This class begins with an examination of the history of video games and of game design. Games will be examined in a systems context to understand gaming and game design fundamentals. Various topics relating directly to the implementation of computer games will be introduced including graphics, animation, artificial intelligence, user interfaces, the simulation of motion, sound generation, and networking. Extensive study of past and current computer games will be used to illustrate course concepts. Individual and group projects will be used throughout the semester to motivate, illustrate and demonstrate the course concepts and ideas. Group game development and implementation projects will culminate in classroom presentation and evaluation. Prereq: EECS 132.

EECS 293. Software Craftsmanship. 4 Units.
A course to improve programming skills, software quality, and the software development process. Software design; Version control; Control issues and routines; Pseudo-code programming process and developer testing; Defensive programming; Classes; Debugging; Self-documenting code; Refactoring. Offered as EECS 293 and EECS 293N. Prereq: Computer Science Major and EECS 233 with a C or higher.

EECS 293N. Software Craftsmanship. 4 Units.
A course to improve programming skills, software quality, and the software development process. Software design; Version control; Control issues and routines; Pseudo-code programming process and developer testing; Defensive programming; Classes; Debugging; Self-documenting code; Refactoring. Offered as EECS 293 and EECS 293N. Prereq: EECS 233 with a C or higher.

EECS 296. Independent Projects. 1 - 3 Units.

EECS 297. Special Topics. 1 - 3 Units.
Special topics in Computer Engineering, Computer Science, Electrical Engineering, and Systems and Control Engineering. Prereq: Limited to freshmen and sophomores.

EECS 301. Digital Logic Laboratory. 2 Units.
This course is an introductory experimental laboratory for digital networks. The course introduces students to the process of design, analysis, synthesis and implementation of digital networks. The course covers the design of combinational circuits, sequential networks, registers, counters, synchronous/asynchronous Finite State Machines, register based design, and arithmetic computational blocks. Prereq: EECS 281.

EECS 302. Discrete Mathematics. 3 Units.
A general introduction to basic mathematical terminology and the techniques of abstract mathematics in the context of discrete mathematics. Topics introduced are mathematical reasoning, Boolean connectives, deduction, mathematical induction, sets, functions and relations, algorithms, graphs, combinatorial reasoning. Offered as EECS 302 and MATH 304. Prereq: MATH 122 or MATH 124 or MATH 126.

EECS 304. Control Engineering I with Laboratory. 3 Units.
Analysis and design techniques for control applications. Linearization of nonlinear systems. Design specifications. Classical design methods: root locus, bode, nyquist. PID, lead, lag, lead-lag controller design. State space modeling, solution, controllability, observability and stability. Modeling and control demonstrations and experiments single-input/single-output and multivariable systems. Control system analysis/design/implementation software. The course will incorporate the use of Grand Challenges in the areas of Energy Systems, Control Systems, and Data Analytics in order to provide a framework for problems to study in the development and application of the concepts and tools studied in the course. Various aspects of important engineering skills relating to leadership, teaming, emotional intelligence, and effective communication are integrated into the course. Prereq: EECS 246 or EMAE 350.

EECS 305. Control Engineering I Laboratory. 1 Unit.
A laboratory course based on the material in EECS 304. Modeling, simulation, and analysis using MATLAB. Physical experiments involving control of mechanical systems, process control systems, and design of PID controllers. Coreq: EECS 304.

EECS 309. Electromagnetic Fields I. 3 Units.
Maxwell’s integral and differential equations, boundary conditions, constitutive relations, energy conservation and Pointing vector, wave equation, plane waves, propagating waves and transmission lines, characteristic impedance, reflection coefficient and standing wave ratio, in-depth analysis of coaxial and strip lines, electro- and magneto-quasistatics, simple boundary value problems, correspondence between fields and circuit concepts, energy and forces. Prereq: PHYS 122 or PHYS 124. Prereq or Coreq: MATH 224.
EECS 313. Signal Processing. 3 Units.
Fourier series and transforms. Analog and digital filters. Fast-Fourier transforms, sampling, and modulation for discrete time signals and systems. Consideration of stochastic signals and linear processing of stochastic signals using correlation functions and spectral analysis. The course will incorporate the use of Grand Challenges in the areas of Energy Systems, Control Systems, and Data Analytics in order to provide a framework for problems to study in the development and application of the concepts and tools studied in the course. Various aspects of important engineering skills relating to leadership, teaming, emotional intelligence, and effective communication are integrated into the course. Prereq: EECS 246.

EECS 314. Computer Architecture. 3 Units.
This course provides the opportunity to study and evaluate a modern computer architecture design. The course covers topics in fundamentals of computer design, performance, cost, instruction set design, processor implementation, control unit, pipelining, communication and network, memory hierarchy, computer arithmetic, input-output, and an introduction to RISC and super-scalar processors. Prereq: EECS 281.

EECS 315. Digital Systems Design. 4 Units.
This course gives students the ability to design modern digital circuits. The course covers topics in fundamentals of computer design, performance, cost, instruction set design, processor implementation, control unit, pipelining, communication and network, memory hierarchy, computer arithmetic, input-output, and an introduction to RISC and super-scalar processors. Prereq: EECS 281.

EECS 316. Computer Design. 3 Units.
Methodologies for systematic design of digital systems with emphasis on programmable logic implementations and prototyping. Laboratory which uses modern design techniques based on hardware description languages such as VHDL, CAD tools, and Field Programmable Gate Arrays (FPGAs). Prereq: EECS 281 and EECS 315.

EECS 318. VLSI/CAD. 4 Units.
With Very Large Scale Integration (VLSI) technology there is an increased need for Computer-Aided Design (CAD) techniques and tools to help in the design of large digital systems that deliver both performance and functionality. Such high performance tools are of great importance in the VLSI design process, both to perform functional, logical, and behavioral modeling and verification to aid the testing process. This course discusses the fundamentals in behavioral languages, both VHDL and Verilog, with hands-on experience. Prereq: EECS 281 and EECS 315.

EECS 319. Applied Probability and Stochastic Processes for Biology. 3 Units.
Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Prereq: BIOI 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419. Prereq: MATH 224 or MATH 223 and BIOL 300 or BIOL 306 and MATH 201 or MATH 307 or consent of instructor.

EECS 321. Semiconductor Electronic Devices. 4 Units.
Energy bands and charge carriers in semiconductors and their experimental verifications. Excess carriers in semiconductors. Principles of operation of semiconductor devices that rely on the electrical properties of semiconductor surfaces and junctions. Development of equivalent circuit models and performance limitations of these devices. Devices covered include: junctions, bipolar transistors, Schottky junctions, MOS capacitors, junction gate and MOS field effect transistors, optical devices such as photodetectors, light-emitting diodes, solar cells, and lasers. Prereq: PHYS 122. Prereq or Coreq: MATH 224.

EECS 322. Integrated Circuits and Electronic Devices. 3 Units.
Technology of monolithic integrated circuits and devices, including crystal growth and doping, photolithography, vacuum technology, metalization, wet etching, thin film basics, oxidation, diffusion, ion implantation, epitaxy, chemical vapor deposition, plasma processing, and micromachining. Basics of semiconductor devices including junction diodes, bipolar junction transistors, and field effect transistors. Prereq: PHYS 122. Prereq or Coreq: MATH 224.
EECS 324. Modeling and Simulation of Continuous Dynamical Systems. 3 Units.
This course examines the computer-based modeling and simulation of continuous dynamical system behavior in a variety of systems including electric power systems, industrial control systems, and signal processing that are represented by a set of differential equations need to be solved numerically in order to compute and represent their behavior for study. In addition to these applications, there are many other important applications of these tools in computer games, virtual worlds, weather forecasting, and population models, to name a few examples. Numerical integration techniques are developed to perform these computations. Multiple computational engines such as Matlab, Simulink, Unity, and physics engines etc. are also examined as examples of commonly used software to solve for and visualize continuous-time system behavior. The course will incorporate the use of Grand Challenges in the areas of Energy Systems, Control Systems, and Data Analytics in order to provide motivation and a framework for problems to study in the development and application of the concepts and tools studied in the course. Various aspects of important engineering skills relating to leadership, teaming, emotional intelligence, and effective communication are integrated into the course. Prereq: MATH 224.

EECS 325. Computer Networks I. 3 Units.
An introduction to computer networks and the Internet. Applications: http, ftp, e-mail, DNS, socket programming. Transport: UDP, TCP reliable data transfer, and congestion control. Network layer: IP, routing, and NAT. Link layer: taxonomy, Ethernet, 802.11. Offered as EECS 325 and EECS 325N. Prereq: Computer Science Major with minimum Junior Standing and EECS 233 with a C or higher.

EECS 325N. Computer Networks I. 3 Units.

EECS 326. Instrumentation Electronics. 3 Units.
A second course in instrumentation with emphasis on sensor interface electronics. General concepts in measurement systems, including accuracy, precision, sensitivity, linearity, and resolution. The physics and modeling of resistive, reactive, self-generating, and direct-digital sensors. Signal conditioning for same, including bridge circuits, coherent detectors, and a variety of amplifier topologies: differential, instrumentation, charge, and transimpedance. Noise and drift in amplifiers and resistors. Practical issues of interference, including grounding, shielding, supply/return, and isolation amplifiers. Prereq: ENGR 210 and (EECS 246, EBM 308 or EMAE 350).

EECS 329. Introduction to Nanomaterials: Material Synthesis, Properties and Device Applications. 3 Units.
The behavior of nanoscale materials is close, to atomic behavior rather than that of bulk materials. The growth of nanomaterials, such as quantum dots, has the tendency to be viewed as an art rather than science. These nanostructures have changed our view of Nature. This course is designed to provide an introduction to nanomaterials and devices to both senior undergraduate and graduate students in engineering. Topics covered include an introduction to growth issues, quantum mechanics, quantization of electronic energy levels in periodic potentials, tunneling, distribution functions and density of states, optical and electronic properties, and devices. Offered as EECS 329 and EECS 429. Coreq: EECS 309.

EECS 337. Compiler Design. 4 Units.
Design and implementation of compilers and other language processors. Scanners and lexical analysis; regular expressions and finite automata; scanner generators; parsers and syntax analysis; context free grammars; parser generators; semantic analysis; intermediate code generation; runtime environments; code generation; machine independent optimizations; data flow and dependence analysis. There will be a significant programming project involving the use of compiler tools and software development tools and techniques. Prereq: EECS 233 and EECS 281.

EECS 338. Intro to Operating Systems and Concurrent Programming. 4 Units.
Intro to OS: OS Structures, processes, threads, CPU scheduling, deadlocks, memory management, file system implementations, virtual machines, cloud computing. Concurrent programming: fork, join, concurrent statement, critical section problem, safety and liveness properties of concurrent programs, process synchronization algorithms, semaphores, monitors. UNIX systems programming: system calls, UNIX System V IPCs, threads, RPCs, shell programming. Offered as EECS 338 and EECS 338N. Prereq: Computer Science Major or Minor and EECS 233 with a C or higher.

EECS 338N. Intro to Operating Systems and Concurrent Programming. 4 Units.
Intro to OS: OS Structures, processes, threads, CPU scheduling, deadlocks, memory management, file system implementations, virtual machines, cloud computing. Concurrent programming: fork, join, concurrent statement, critical section problem, safety and liveness properties of concurrent programs, process synchronization algorithms, semaphores, monitors. UNIX systems programming: system calls, UNIX System V IPCs, threads, RPCs, shell programming. Offered as EECS 338 and EECS 338N. Prereq: Computer Science Major or Minor and EECS 233 with a C or higher.

EECS 339. Web Data Mining. 3 Units.
Web crawling technology, web search and information extraction, unsupervised and semi-supervised learning techniques and their application to web data extraction, social network analysis, various pagerank algorithms, link analysis, web resource discovery, web, resource description framework (RDF), XML, Web Ontology Language (OWL). Prereq: EECS 338, EECS 341, and (EECS 302 or MATH 304).

EECS 340. Algorithms. 3 Units.
Fundamentals in algorithm design and analysis. Loop invariants, asymptotic notation, recurrence relations, sorting algorithms, divide-and-conquer, dynamic programming, greedy algorithms, basic graph algorithms. Offered as EECS 340 and EECS 340N. Prereq: (Computer Science Major/Minor or Data Science Major) and (EECS 302 or MATH 304) and (EECS 233 or DSCI 234 with a C or higher).

EECS 340N. Algorithms. 3 Units.
Fundamentals in algorithm design and analysis. Loop invariants, asymptotic notation, recurrence relations, sorting algorithms, divide-and-conquer, dynamic programming, greedy algorithms, basic graph algorithms. Offered as EECS 340 and EECS 340N. Prereq: (EECS 302 or MATH 304) and EECS 233 with a C or higher.

EECS 341. Introduction to Database Systems. 3 Units.
Relational model, ER model, relational algebra and calculus, SQL, OBE, security, views, files and physical database structures, query processing and query optimization, normalization theory, concurrency control, object relational systems, multimedia databases, Oracle SQL server, Microsoft SQL server. Offered as EECS 341 and EECS 341N. Prereq: Computer Science Major and (EECS 302 or MATH 304) and EECS 233 with a C or higher.
EECS 341N. Introduction to Database Systems. 3 Units.
Relational model, ER model, relational algebra and calculus, SQL, OBE, security, views, files and physical database structures, query processing and query optimization, normalization theory, concurrency control, object relational systems, multimedia databases, Oracle SQL server, Microsoft SQL server. Offered as EECS 341 and EECS 341N. Prereq: (EECS 302 or MATH 304) and EECS 233 with a C or higher.

EECS 342. Introduction to Global Issues. 3 Units.
This systems course is based on the paradigm of the world as a complex system. Global issues such as population, world trade and financial markets, resources (energy, water, land), global climate change, and others are considered with particular emphasis put on their mutual interdependence. A reasoning support computer system which contains extensive data and a family of models is used for future assessment. Students are engaged in individual, custom-tailored, projects of creating conditions for a desirable or sustainable future based on data and scientific knowledge available. Students at CWRU will interact with students from fifteen universities that have been strategically selected in order to give global coverage to UNESCO’S Global-probлематique Education Network Initiative (GENIe) in joint, participatory scenario analysis via the internet.

EECS 342I. Global Issues, Health, & Sustainability in India. 3 Units.
Global Issues, Health, & Sustainability in India is an interdisciplinary social work and engineering collaboration that includes a short-term cross-cultural immersion. This course brings together social work (knowledge, values, and skills) and health care (promotion, education, and community) perspectives to the understanding of technical project assessment, selection, planning and implementation in India. The course is also designed to help students understand culturally relevant community engagement strategies to ensure project acceptance in underserved and developing communities. Many field sites will be visited in order to observe first-hand the community assessment and development of projects that engineers implement. An example of these projects could include infrastructure to support green energy and water (resource planning, development, conservation, and sanitation). This study abroad course will acquaint students with history and culture of India, its socio-political and economic development and the impact it has on health and the delivery of social services. Participants will learn about factors affecting the abilities to reach, treat, educate, and equip communities to improve health outcomes. Engineering students will learn the quantitative aspects using a paradigm of hierarchical systems, mathematical modeling, and scenario analysis using a ‘reasoning support’ system. Together the engineering, social work, and health sciences students in disciplinary-balanced teams will jointly work on real and meaningful projects marrying the descriptive scenarios (that is the ‘subjective’ aspect) with the numerical scenario analysis based on mathematical modeling (or ‘objective’ aspect) to form a coherent view of the future. The course will be taught using both lecture and experiential modalities. Engineering students will conduct computer modeling work. Along with visiting a variety of governmental and non-governmental institutions, organizations and projects, students will visit historical sites and attend cultural events. Offered as EECS 342I and SASS 375I. Counts for CAS Global & Cultural Diversity Requirement.

EECS 343. Theoretical Computer Science. 3 Units.
Introduction to different classes of automata and their correspondence to different classes of formal languages and grammars, computability, complexity and various proof techniques. Offered as EECS 343 and MATH 343. Prereq: EECS 302 or MATH 304.

EECS 344. Electronic Analysis and Design. 3 Units.
The design and analysis of real-world circuits. Topics include: junction diodes, non-ideal op-amp models, characteristics and models for large and small signal operation of bipolar junction transistors (BJTs) and field effect transistors (FETs), selection of operating point and biasing for BJT and FET amplifiers. Hybrid-pi model and other advanced circuit models, cascaded amplifiers, negative feedback, differential amplifiers, oscillators, tuned circuits, and phase-locked loops. Computers will be extensively used to model circuits. Selected experiments and/or laboratory projects. Prereq: EECS 245.

EECS 345. Programming Language Concepts. 3 Units.
This course examines the four main programming paradigms: imperative, object-oriented, functional, and logical. It is assumed that students will come to the course with significant exposure to object-oriented programming and some exposure to imperative programming. The course will teach the functional paradigm in depth, enhance the students’ knowledge of the object-oriented and imperative paradigms, and introduce the logical paradigm. The course will explore language syntax, semantics, names/scopes, types, expressions, assignment, subprograms, abstraction and inheritance. This exploration will have several forms. Students will study the programming language concepts at a theoretical level, use the concepts in functional language programming, and implement the concepts by designing language interpreters. Offered as EECS 345 and EECS 345N. Prereq: Computer Science Major and (EECS 302 or MATH 304) and EECS 233 with a C or higher.

EECS 345N. Programming Language Concepts. 3 Units.
This course examines the four main programming paradigms: imperative, object-oriented, functional, and logical. It is assumed that students will come to the course with significant exposure to object-oriented programming and some exposure to imperative programming. The course will teach the functional paradigm in depth, enhance the students’ knowledge of the object-oriented and imperative paradigms, and introduce the logical paradigm. The course will explore language syntax, semantics, names/scopes, types, expressions, assignment, subprograms, abstraction and inheritance. This exploration will have several forms. Students will study the programming language concepts at a theoretical level, use the concepts in functional language programming, and implement the concepts by designing language interpreters. Offered as EECS 345 and EECS 345N. Prereq: (EECS 302 or MATH 304) and EECS 233 with a C or higher.

EECS 346. Engineering Optimization. 3 Units.
Optimization techniques including linear programming and extensions; transportation and assignment problems; network flow optimization; quadratic, integer, and separable programming; geometric programming; and dynamic programming. Nonlinear optimization topics: optimality criteria, gradient and other practical unconstrained and constrained methods. Computer applications using engineering and business case studies. The course will incorporate the use of Grand Challenges in the areas of Energy Systems, Control Systems, and Data Analytics in order to provide a framework for problems to study in the development and application of the concepts and tools studied in the course. Various aspects of important engineering skills relating to leadership, teaming, emotional intelligence, and effective communication are integrated into the course. Recommended preparation: MATH 201.
EECS 350. Operations and Systems Design. 3 Units.
Introduction to design, modeling, and optimization of operations and scheduling systems with applications to computer science and engineering problems. Topics include, forecasting and time series, strategic, tactical, and operational planning, life cycle analysis, learning curves, resources allocation, materials requirement and capacity planning, sequencing, scheduling, inventory control, project management and planning. Tools for analysis include: multi-objective optimization, queuing models, simulation, and artificial intelligence.

EECS 351. Communications and Signal Analysis. 3 Units.
Fourier transform analysis and sampling of signals. AM, FM and SSB modulation and other modulation methods such as pulse code, delta, pulse position, PSK and FSK. Detection, multiplexing, performance evaluation in terms of signal-to-noise ratio and bandwidth requirements. Prereq: EECS 246 or requisites not met permission.

EECS 352. Engineering Economics and Decision Analysis. 3 Units.
Economic analysis of engineering projects, focusing on financial decisions concerning capital investments. Present worth, annual worth, internal rate of return, benefit/cost ratio. Replacement and abandonment policies, effects of taxes, and inflation. Decision making under risk and uncertainty. Decision trees. Value of information. The course will incorporate the use of Grand Challenges in the areas of Energy Systems, Control Systems, and Data Analytics in order to provide a framework for problems to study in the development and application of the concepts and tools studied in the course. Various aspects of important engineering skills relating to leadership, teaming, emotional intelligence, and effective communication are integrated into the course.

EECS 354. Digital Communications. 3 Units.

EECS 356. Computer Graphics. 3 Units.

EECS 358. Power System Analysis I. 3 Units.
This course introduces the steady-state modeling and analysis of electric power systems. The course discusses the modeling of essential power network components such as transformers and transmission lines. The course also discusses important steady-state analysis of three-phase power system network, such as the power flow and economic operation studies. Through the use of PowerWorld Simulator education software, further understanding and knowledge can be gained on the operational characteristics of AC power systems. Special topics concerning new grid technologies will be discussed towards the semester end. The prerequisite requirements of the course include the concepts and computational techniques of Alternative Current (AC) circuit and electromagnetic field. Offered as EECS 368 and EECS 468. Prereq: EECS 245.

EECS 359. Power System Analysis II. 3 Units.
This course extends upon the steady state analysis of power systems to cover study topics that are essential for power system planning and operation. Special system operating conditions are considered, such as unbalanced network operation and component faults. Among the most important analytical methods developed, are symmetrical components and sequence networks. Other study topics discussed include the electric machine modeling and power system transient stability. The latter half of the course presents computational methods and control algorithms that are essential for power system operation, such as generation control and state estimation. Offered as EECS 369 and EECS 469. Prereq: EECS 368.

EECS 360. Manufacturing and Automated Systems. 3 Units.
Formulation, modeling, planning, and control of manufacturing and automated systems with applications to computer science and engineering problems. Topics include, design of products and processes, location/spatial problems, transportation and assignment, product and process layout, group technology and clustering, cellular and network flow layouts, computer control systems, reliability and maintenance, and statistical quality control. Tools and analysis include: multi-objective optimization, artificial intelligence, and heuristics for combinatorial problems. Offered as EECS 360 and EECS 460.

EECS 365. Complex Systems Biology. 3 Units.
Complex Systems Biology is an interdisciplinary course based on systems science, engineering, biology, and medicine. The objective is to provide students with an understanding of the current state of systems biology and major challenges ahead. The biological phenomena across the level of complexity will be considered from molecular to organisms and ecology to provide universality of the systems concepts for understanding the functions and behavior of biological systems. Case studies are used and a course project is required to be completed. Prereq: Junior Standing.
EECS 371. Applied Circuit Design. 4 Units.
This course will consist of lectures and lab projects designed to provide students with an opportunity to consolidate their theoretical knowledge of electronics and to acquaint them with the art and practice of circuit and product design. The lectures will cover general and electronic circuits and many electronic and electrical devices and applications. Examples include mixed-signal circuits, power electronics, magnetic and piezo components, gas discharge devices, sensors, motors and generators, and power systems. In addition, there will be discussion of professional topics such as regulatory agencies, manufacturing, testing, reliability, and product cost. Weekly labs will be true “design” opportunities representing real-world applications. A specification or functional description will be provided, and the students will design the circuit, select all components, construct a breadboard, and test. The objective will be functional, pragmatic, cost-effective designs. Prereq: EECS 245.

EECS 374. Advanced Control and Energy Systems. 3 Units.
This course introduces applied quantitative robust and nonlinear control engineering techniques to regulate automatically renewable energy systems in general and wind turbines in particular. The course also studies the fundamentals for dynamic multidisciplinary modeling and analysis of large multi-megawatt wind turbines (mechanics, aerodynamics, electrical systems, control concepts, etc.). The course combines lecture sessions and lab hours. The 400-level includes an experimental lab competition, where the object is to design, implement, and experimentally validate a control strategy to regulate a real system in the laboratory (helicopter control competition or similar); it will also include additional project design reports. Offered as EECS 374 and EECS 474. Prereq: EECS 304.

EECS 375. Applied Control. 3 Units.
This course provides a practical treatment of the study of control engineering systems. It emphasizes best practices in industry so that students learn what aspects of plant and control system design are critical. The course develops theory and practice for digital computer control systems; PID controller design (modes, forms and tuning methods); Control structure design (feed-forward, cascade control, predictive control, disturbance observers, multi-loop configurations, multivariable control); Actuators, sensors and common loops; Dynamic performance evaluation; and some advanced control techniques (quantitative robust control, gain-scheduling and adaptive control) to achieve a good performance over a range of operating conditions. Recommended preparation: EECS 374 or EECS 474. Offered as EECS 375 and EECS 475. Prereq: EECS 304 or Requisites Not Met permission.

EECS 376. Mobile Robotics. 4 Units.
Design of software systems for mobile robotic control, including: motion control; sensory processing; localization and mapping; mobile-robot planning and navigation; and implementation of goal-directed behaviors. The course has a heavy lab component involving a sequence of design challenges and competitions performed in teams. Prereq: ENGR 131 or EECS 233.

EECS 390. Advanced Game Development Project. 3 Units.
This game development project course will bring together an interdisciplinary group of advanced undergraduate students in the fields of Electrical Engineering and Computer Science, Art, Music, and English to focus on the design and development of a complete, fully-functioning computer game (as an interdisciplinary team). The student teams are given complete liberty to design their own fully functional games from their original concept to a playable finished product, i.e., from the initial idea through to the wrapped box. The student teams will experience the entire game development cycle as they execute their projects. Responsibilities include creating a game idea, writing a story, developing the artwork, designing characters, implementing music and sound effects, programming and testing the game, and documenting the entire project. Recommended preparation: Junior or Senior standing and consent of instructor. Prereq: EECS 233 and EECS 290.

EECS 391. Introduction to Artificial Intelligence. 3 Units.
This course is an introduction to artificial intelligence. We will study the concepts that underlie intelligent systems. Topics covered include problem solving with search, constraint satisfaction, adversarial games, knowledge representation and reasoning using propositional and first order logic, reasoning under uncertainty, introduction to machine learning, automated planning, reinforcement learning and natural language processing. Recommended: basic knowledge of probability and statistics. Prereq: ENGR 131 or EECS 132.

EECS 392. App Development for iOS. 3 Units.
This course is an introduction to app development for iPhone and iPad using Cocoa Touch Framework and Xcode development environment. Topics include Objective-C programming language and iOS SDK/ foundations, object-oriented design and model-view-controller framework, user interface design using Xcode. Additional topics may include data management, map applications, animations and some recent developments in iOS. Recommended preparations: experiences in object-oriented programming and Mac OS; knowledge in software engineering and databases. Prereq: EECS 293 and Junior or Senior standing.

EECS 393. Software Engineering. 3 Units.
Topics: Introduction to software engineering; software lifecycle models; development team organization and project management; requirements analysis and specification techniques; software design techniques; programming practices; software validation techniques; software maintenance practices; software engineering ethics. Undergraduates work in teams to complete a significant software development project. Graduate students are required to complete a research project. Offered as EECS 393, EECS 393N, and EECS 493. Counts as SAGES Senior Capstone. Prereq: (Computer Science Major/Minor or Data Science Major) or (EECS 233 or DSCI 234 with a C or higher).

EECS 393N. Software Engineering. 3 Units.
Topics: Introduction to software engineering; software lifecycle models; development team organization and project management; requirements analysis and specification techniques; software design techniques; programming practices; software validation techniques; software maintenance practices; software engineering ethics. Undergraduates work in teams to complete a significant software development project. Graduate students are required to complete a research project. Offered as EECS 393, EECS 393N, and EECS 493. Counts as SAGES Senior Capstone. Prereq: EECS 233 with a C or higher.
EECS 394. Introduction to Information Theory. 3 Units.
This course is intended as an introduction to information and coding theory with emphasis on the mathematical aspects. It is suitable for advanced undergraduate and graduate students in mathematics, applied mathematics, statistics, physics, computer science and electrical engineering. Course content: Information measures-entropy, relative entropy, mutual information, and their properties. Typical sets and sequences, asymptotic equipartition property, data compression. Channel coding and capacity: channel coding theorem. Differential entropy, Gaussian channel, Shannon-Nyquist theorem. Information theory inequalities (400 level). Additional topics, which may include compressed sensing and elements of quantum information theory. Recommended preparation: MATH 201 or MATH 307. Offered as MATH 394, EECS 394, MATH 494 and EECS 494. Prereq: MATH 223 and MATH 380 or requisites not met permission.

EECS 395. Senior Project in Computer Science. 4 Units.
Capstone course for computer science seniors. Material from previous and concurrent courses used to solve computer programming problems and to develop software systems. Professional engineering topics such as project management, engineering design, communications, and professional ethics. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Scheduled formal project presentations during last week of classes. Counts as SAGES Senior Capstone. Prereq: Senior standing.

EECS 396. Independent Projects. 1 - 6 Units.

EECS 397. Special Topics. 1 - 6 Units.
Special topics in Computer Engineering, Computer Science, Electrical Engineering, and Systems and Control Engineering. Prereq: Limited to juniors and seniors.

EECS 398. Engineering Projects I. 4 Units.
Capstone course for electrical, computer and systems and control engineering seniors. Material from previous and concurrent courses used to solve engineering design problems. Professional engineering topics such as project management, engineering design, communications, and professional ethics. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Scheduled formal project presentations during last week of classes. Counts as SAGES Senior Capstone. Prereq: Senior standing. Prereq or Coreq: ENGR 398 and ENGL 398.

EECS 399. Engineering Projects II. 3 Units.
Continuation of EECS 398. Material from previous and concurrent courses applied to engineering design and research. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Prereq: Senior Standing.

EECS 400T. Graduate Teaching I. 0 Unit.
This course will provide the Ph.D. candidate with experience in teaching undergraduate or graduate students. The experience is expected to involve direct student contact but will be based upon the specific departmental needs and teaching obligations. This teaching experience will be conducted under the supervision of the faculty member who is responsible for the course, but the academic advisor will assess the educational plan to ensure that it provides an educational experience for the student. Students in this course may be expected to perform one or more of the following teaching related activities: grading homeworks, quizzes, and exams, having office hours for students, tutoring students. Recommended preparation: Ph.D. student in EECS department.

EECS 401. Digital Signal Processing. 3 Units.

EECS 402. Internet Security and Privacy. 3 Units.
This course introduces students to research on Internet security and privacy. Covered topics include denial of service attacks, attacks enabled by man-in-the-middle surveillance, communication hijacking, botnet and fast-flux networks, email and Web spam, threats to privacy on the Internet, and Internet censorship. The course will be based on a collection of research papers. Students will be required to attend lectures, read the materials, prepare written summaries of discussed papers, present a paper in class, complete a course project and take the final exam (in the form of the course project presentation). Prereq: EECS325 or EECS425 or graduate standing in Computer Science or Computer Engineering.

EECS 404. Digital Control Systems. 3 Units.
Analysis and design techniques for computer based control systems. Sampling, hybrid continuous-time/discrete-time system modeling; sampled data and state space representations, controllability, observability and stability; transformation of analog controllers, design of deadbeat and state feedback controllers; pole placement controllers based on input/output models, introduction to model identification, optimal control and adaptive control. Recommended Preparation: EECS 304 or equivalent.

EECS 405. Data Structures and File Management. 3 Units.
Fundamental concepts: sequential allocation, linked allocation, lists, trees, graphs, internal sorting, external sorting, sequential, binary, interpolation search, hashing file, indexed files, multiple level index structures, btrees, hashed files. Multiple attribute retrieval; inverted files, multi lists, multiple-key hashing, hd trees. Introduction to data bases. Data models. Recommended preparation: EECS 233 and MATH 304.

EECS 408. Introduction to Linear Systems. 3 Units.
EECS 410. Mobile Health (mHealth) Technology. 3 Units.
Advances in communications, computer, and medical technology have facilitated the practice of personalized health, which utilizes sensory computational communication systems to support improved and more personalized healthcare and healthy lifestyle choices. The current proliferation of broadband wireless services, along with more powerful and convenient handheld devices, is helping to introduce real-time monitoring and guidance for a wide array of patients. Indeed, a large research community and a nascent industry is beginning to connect medical care with technology developers, vendors of wireless and sensing hardware systems, network service providers, and enterprise data management communities. Students in the course and labs will explore cutting-edge technologies in 1) information technologies and 2) healthcare/medical applications, through lectures, lab assignments, exams, presentations, and final projects. The overall course objectives are to introduce electrical engineering, computer engineering, and computer science students the fundamentals of wearable sensors, mobile health informatics, big data analysis, telehealthcare security & privacy, and human computer interaction considerations.

EECS 411. Applied Engineering Statistics. 3 Units.
In this course a combination of lectures, demonstrations, case studies, and individual and group computer problems provides an intensive introduction to fundamental concepts, applications and the practice of contemporary engineering statistics. Each topic is introduced through realistic sample problems to be solved first by using standard spreadsheet programs and then using more sophisticated software packages. Primary attention is given to teaching the fundamental concepts underlying standard analysis methods. Offered as EPOM 405 and EECS 411.

EECS 413. Nonlinear Systems I. 3 Units.
This course will provide an introduction to techniques used for the analysis of nonlinear dynamic systems. Topics will include existence and uniqueness of solutions, phase plane analysis of two dimensional systems including Poincare-Bendixson, describing functions for single-input single-output systems, averaging methods, bifurcation theory, stability, and an introduction to the study of complicated dynamics and chaos. Recommended preparation: Concurrent enrollment in EECS 408.

EECS 414. Wireless Communications. 3 Units.
This course introduces the fundamentals of wireless communications including backgrounds, important concepts, and cutting-edge technologies. In particular, the course focuses on interesting and important topics in wireless communications, such as (but not limited to): Overview of wireless communication networks and protocols, the cellular concept, system design fundamentals, brief introduction to wireless physical layer fundamentals, multiple access control protocols for wireless systems, wireless networking (routing/rerouting, wireless TCP/IP), mobility management, call admission control and resource allocation, revolution/evolution towards future generation wireless networks, overview of wireless mesh networks, mobile ad hoc networks and wireless sensor networks, and wireless security (optional). Prereq: Undergraduate student with a C or better in EECS 351, or Graduate student.

EECS 415. Integrated Circuit Technology I. 3 Units.

EECS 416. Convex Optimization for Engineering. 3 Units.
This course will focus on the development of a working knowledge and skills to recognize, formulate, and solve convex optimization problems that are so prevalent in engineering. Applications in control systems; parameter and state estimation; signal processing; communications and networks; circuit design; data modeling and analysis; data mining including clustering and classification; and combinatorial and global optimization will be highlighted. New reliable and efficient methods, particular those based on interior-point methods and other special methods to solve convex optimization problems will be emphasized. Implementation issues will also be underscored. Recommended preparation: MATH 201 or equivalent.

EECS 418. System Identification and Adaptive Control. 3 Units.

EECS 419. Computer System Architecture. 3 Units.
Interaction between computer systems hardware and software. Pipeline techniques - instruction pipelines - arithmetic pipelines. Instruction level parallelism. Cache mechanism. I/O structures. Examples taken from existing computer systems.

EECS 421. Optimization of Dynamic Systems. 3 Units.

EECS 422. Solid State Electronics II. 3 Units.

EECS 424. Introduction to Nanotechnology. 3 Units.
An exploration of emerging nanotechnology research. Lectures and class discussion on 1) nanostructures: superlattices, nanowires, nanotubes, quantum dots, nanoparticles, nanocomposites, proteins, bacteria, DNA; 2) nanoscale physical phenomena: mechanical, electrical, chemical, thermal, biological, optical, magnetic; 3) nanofabrication: bottom up and top down methods; 4) characterization: microscopy, property measurement techniques; 5) devices/applications: electronics, sensors, actuators, biomedical, energy conversion. Topics will cover interdisciplinary aspects of the field. Offered as EECS 424 and EMAE 424.

EECS 425. Computer Networks I. 3 Units.

EECS 426. MOS Integrated Circuit Design. 3 Units.
EECS 427. Optoelectronic and Photonic Devices. 3 Units.
In this course, we will study the optical transitions, absorptions, and gains in semiconductors. We will discuss the optical processes in semiconductor bulk as well as low dimensional structures such as quantum well and quantum dot. The fundamentals, technologies and applications of important optoelectronic devices (e.g., light-emitting diodes, semiconductor lasers, solar cells and photo-detectors) will be introduced. We will learn the current state-of-the-art of these devices. Recommended Preparation: EECS 321.

EECS 428. Computer Communications Networks II. 3 Units.
Introduction to topics and methodology in computer networks and middleware research. Traffic characterization, stochastic models, and self-similarity. Congestion control (Tahoe, Reno, Sack), Active Queue Management (RED, FQ) and explicit QoS. The Web: overview and components, HTTP, its interaction with TCP, caching. Overlay networks and CDN. Expected work includes a course-long project on network simulation, a final project, a paper presentation, midterm, and final test. Recommended preparation: EECS 425 or permission of instructor.

EECS 429. Introduction to Nanomaterials: Material Synthesis, Properties and Device Applications. 3 Units.
The behavior of nanoscale materials is close, to atomic behavior rather than that of bulk materials. The growth of nanomaterials, such as quantum dots, has the tendency to be viewed as an art rather than science. These nanostructures have changed our view of Nature. This course is designed to provide an introduction to nanomaterials and devices to both senior undergraduate and graduate students in engineering. Topics covered include an introduction to growth issues, quantum mechanics, quantization of electronic energy levels in periodic potentials, tunneling, distribution functions and density of states, optical and electronic properties, and devices. Offered as EECS 329 and EECS 429.

EECS 433. Database Systems. 3 Units.

EECS 434. Microfabricated Silicon Electromechanical Systems. 3 Units.

EECS 435. Data Mining. 3 Units.
Data Mining is the process of discovering interesting knowledge from large amounts of data stored either in databases, data warehouses, or other information repositories. Topics to be covered includes: Data Warehouse and OLAP technology for data mining, Data Preprocessing, Data Mining Primitives, Languages, and System Architectures, Mining Association Rules from Large Databases, Classification and Prediction, Cluster Analysis, Mining Complex Types of Data, and Applications and Trends in Data Mining. Recommended preparation: EECS 341 or equivalent.

EECS 439. Web Data Mining. 3 Units.
Web crawling technology, web search and information extraction, unsupervised and semi-supervised learning techniques and their application to web data extraction, social network analysis, various pagerank algorithms, link analysis, web resource discovery, web, resource description framework (RDF), XML, Web Ontology Language (OWL). Recommended preparation: EECS 338, EECS 341.

EECS 440. Machine Learning. 3 Units.
Machine learning is a subfield of Artificial Intelligence that is concerned with the design and analysis of algorithms that "learn" and improve with experience. While the broad aim behind research in this area is to build systems that can simulate or even improve on certain aspects of human intelligence, algorithms developed in this area have become very useful in analyzing and predicting the behavior of complex systems. Machine learning algorithms have been used to guide diagnostic systems in medicine, recommend interesting products to customers in e-commerce, play games at human championship levels, and solve many other very complex problems. This course is focused on algorithms for machine learning: their design, analysis and implementation. We will study different learning settings, including supervised, semi-supervised and unsupervised learning. We will study different ways of representing the learning problem, using propositional, multiple-instance and relational representations. We will study the different algorithms that have been developed for these settings, such as decision trees, neural networks, support vector machines, k-means, harmonic functions and Bayesian methods. We will learn about the theoretical tradeoffs in the design of these algorithms, and how to evaluate their behavior in practice. At the end of the course, you should be able to: --Recognize situations where machine learning algorithms are applicable; --Understand, represent and formulate the learning problem; --Apply the appropriate algorithm(s), or if necessary, design your own, with an understanding of the tradeoffs involved; --Correctly evaluate the behavior of the algorithm when solving the problem. Prereq: EECS 391 or EECS 491 or consent of instructor.

EECS 441. Internet Applications. 3 Units.
This course exposes students to research in building and scaling internet applications. Covered topics include Web services, scalable content delivery, applications of peer-to-peer networks, and performance analysis and measurements of internet application platforms. The course is based on a collection of research papers and protocol specifications. Students are required to read the materials, present a paper in class, prepare short summaries of discussed papers, and do a course project (team projects are encouraged).
EECS 442. Causal Learning from Data. 3 Units.
This course introduces key concepts and techniques for characterizing, from observational or experimental study data and from background information, the causal effect of a specific treatment, exposure, or intervention (e.g., a medical treatment) upon an outcome of interest (e.g., disease status). The fundamental problem of causal inference is the impossibility of observing the effects of different and incompatible treatments on the same individual or unit. This problem is overcome by estimating an average causal effect over a study population. Making valid causal inferences with observational data is especially challenging, because of the greater potential for biases (confounding bias, selection bias, and measurement bias) that can badly distort causal effect estimates. Consequently, this topic has been the focus of intense cross-disciplinary research in recent years. Causal inference techniques will be illustrated by applications in several fields such as computer science, engineering, medicine, public health, biology, genomics, neuroscience, economics, and social science. Course grading will be based on quizzes, homeworks, a class presentation, and a causal data analysis project.
Specific topics: treatments, exposures, and interventions; causal effects and causal effect measures; confounding bias; potential outcomes and counterfactuals; randomized experiments; observational studies; causal directed acyclic graphs (DAGs); exchangeability and conditional exchangeability; effect modification; causal interactions; nonparametric structural equations; Pearl’s Back-Door Criterion, Front-Door Criterion, and related results; covariate adjustment; matching on covariates; selection bias; measurement bias; instrumental variables; causal modeling; inverse probability weighting; marginal structural models; standardization; structural nested models; outcome regression; propensity scores; sensitivity analysis. Prereq: EECS 440 or MATH 380 or STAT 312 or STAT 313 or STAT 332 or Requisites Not Met permission.

EECS 444. Computer Security. 3 Units.
General types of security attacks; approaches to prevention; secret key and public key cryptography; message authentication and hash functions; digital signatures and authentication protocols; information gathering; password cracking; spoofing; session hijacking; denial of service attacks; buffer overruns; viruses, worms, etc.; principles of secure software design, threat modeling; access control; least privilege; storing secrets; socket security; RPC security; security testing; secure software installation; operating system security; database security; web security; email security; firewalls; intrusions. Recommended preparation: EECS 337.

EECS 450. Operations and Systems Design. 3 Units.
Introduction to design, modeling, and optimization of operations and scheduling systems with applications to computer science and engineering problems. Topics include, forecasting and times series, strategic, tactical, and operational planning, life cycle analysis, learning curves, resources allocation, materials requirement and capacity planning, sequencing, scheduling, inventory control, project management and planning. Tools for analysis include: multi-objective optimization, queuing models, simulation, and artificial intelligence.

EECS 452. Random Signals. 3 Units.

EECS 454. Analysis of Algorithms. 3 Units.
This course covers fundamental topics in algorithm design and analysis in depth. Amortized analysis, NP-completeness and reductions, dynamic programming, advanced graph algorithms, string algorithms, geometric algorithms, local search heuristics. Offered as EECS 454 and OPRE 454. Prereq: EECS 340.

EECS 458. Introduction to Bioinformatics. 3 Units.

EECS 459. Bioinformatics for Systems Biology. 3 Units.

EECS 460. Manufacturing and Automated Systems. 3 Units.
Formulation, modeling, planning, and control of manufacturing and automated systems with applications to computer science and engineering problems. Topics include, design of products and processes, location/spatial problems, transportation and assignment, product and process layout, group technology and clustering, cellular and network flow layouts, computer control systems, reliability and maintenance, and statistical quality control. Tools and analysis include: multi-objective optimization, artificial intelligence, and heuristics for combinatorial problems. Offered as EECS 360 and EECS 460.

EECS 466. Computer Graphics. 3 Units.
Theory and practice of computer graphics: object and environment representation including coordinate transformations image extraction including perspective, hidden surface, and shading algorithms; and interaction. Covers a wide range of graphic display devices and systems with emphasis in interactive shaded graphics. Laboratory. Recommended preparation: EECS 233.
EECS 467. Commercialization and Intellectual Property Management. 3 Units.
This interdisciplinary course covers a variety of topics, including principles of intellectual property and intellectual property management, business strategies and modeling relevant to the creation of start-up companies and exploitation of IP rights as they relate to biomedical-related inventions. The goal of this course is to address issues relating to the commercialization of biomedical-related inventions by exposing law students, MBA students, and Ph.D. candidates (in genetics and proteomics) to the challenges and opportunities encountered when attempting to develop biomedical intellectual property from the point of early discovery to the clinic and market. Specifically, this course seeks to provide students with the ability to value a given technological advance or invention holistically, focusing on issues that extend beyond scientific efficacy and include patient and practitioner value propositions, legal and intellectual property protection, business modeling, potential market impacts, market competition, and ethical, social, and healthcare practitioner acceptance. During this course, law students, MBA students, and Ph.D. candidates in genomics and proteomics will work in teams of five (two laws students, two MBA students and one Ph.D. candidate), focusing on issues of commercialization and IP management of biomedical-related inventions. The instructors will be drawn from the law school, business school, and technology-transfer office. Please visit the following website for more information: fusioninnovate.com. Offered as LAWS 5341, MGMT 467, GENE 367, GENE 467, EBME 467 and EECS 467.

EECS 468. Power System Analysis I. 3 Units.
This course introduces the steady-state modeling and analysis of electric power systems. The course discusses the modeling of essential power system network components such as transformers and transmission lines. The course also discusses important steady-state analysis of three-phase power system network, such as the power flow and economic operation studies. Through the use of PowerWorld Simulator education software, further understanding and knowledge can be gained on the operational characteristics of AC power systems. Special topics concerning new grid technologies will be discussed towards the semester end. The prerequisite requirements of the course include the concepts and computational techniques of Alternative Current (AC) circuit and electromagnetic field. Offered as EECS 368 and EECS 468. Prereq: EECS 245.

EECS 469. Power System Analysis II. 3 Units.
This course extends upon the steady state analysis of power systems to cover study topics that are essential for power system planning and operation. Special system operating conditions are considered, such as unbalanced network operation and component faults. Among the most important analytical methods developed, are symmetrical components and sequence networks. Other study topics discussed include the electric machine modeling and power system transient stability. The latter half of the course presents computational methods and control algorithms that are essential for power system operation, such as generation control and state estimation. Offered as EECS 369 and EECS 469. Prereq: EECS 368.

EECS 470. Smart Grid. 3 Units.
This course starts with an introduction to the US electric power system infrastructure and national electricity policy. Then power system operations and reliability practices are described. In the context of currently existing infrastructure and operation strategies, the course discusses the new Smart Grid technologies such as renewable resources, distributed generation, demand response, energy storage and electric vehicles. Additional important topics of discussion include Advanced Meter Infrastructure, microgrids, the IEEE 1547 Interconnection Standard, and other interoperability standards. The course captures the evolving progress made in Smart Grid technologies and the impacts on power system economics and reliability. Offered as EECS 370 and EECS 470. Prereq: EECS 368.

EECS 474. Advanced Control and Energy Systems. 3 Units.
This course introduces applied quantitative robust and nonlinear control engineering techniques to regulate automatically renewable energy systems in general and wind turbines in particular. The course also studies the fundamentals for dynamic multidisciplinary modeling and analysis of large multi-megawatt wind turbines (mechanics, aerodynamics, electrical systems, control concepts, etc.). The course combines lecture sessions and lab hours. The 400-level includes an experimental lab competition, where the object is to design, implement, and experimentally validate a control strategy to regulate a real system in the laboratory (helicopter control competition or similar); it will also include additional project design reports. Offered as EECS 374 and EECS 474. Prereq: EECS 304.

EECS 475. Applied Control. 3 Units.
This course provides a practical treatment of the study of control engineering systems. It emphasizes best practices in industry so that students learn what aspects of plant and control system design are critical. The course develops theory and practice for digital computer control systems; PID controller design (modes, forms and tuning methods); Control structure design (feed-forward, cascade control, predictive control, disturbance observers, multi-loop configurations, multivariable control); Actuators, sensors and common loops; Dynamic performance evaluation; and some advanced control techniques (quantitative robust control, gain-scheduling and adaptive control) to achieve a good performance over a range of operating conditions. Recommended preparation: EECS 374 or EECS 474. Offered as EECS 375 and EECS 475. Prereq: EECS 304 or Requisites Not Met permission.

EECS 476. Mobile Robotics. 3 Units.
Design of software systems for mobile robot control, including: motion control; sensory processing; localization and mapping; mobile-robot planning and navigation; and implementation of goal-directed behaviors. The course has a heavy lab component involving a sequence of design challenges and competitions performed in teams.

EECS 477. Advanced Algorithms. 3 Units.
EECS 478. Computational Neuroscience. 3 Units.
Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECS 478, MATH 478 and NEUR 478.

EECS 480A. Introduction to Wireless Health. 3 Units.
Study of convergence of wireless communications, microsystems, information technology, persuasive psychology, and health care. Discussion of health care delivery system, medical decision-making, persuasive psychology, and wireless health value chain and business models. Understanding of health information technology, processing of monitoring data, wireless communication, biomedical sensing techniques, and health monitoring technical approaches and solutions. Offered as EECS 480A and EBME 480A.

EECS 480B. The Human Body. 3 Units.
Study of structural organization of the body. Introduction to anatomy, physiology, and pathology, covering the various systems of the body. Comparison of elegant and efficient operation of the body and the related consequences of when things go wrong, presented in the context of each system of the body. Introduction to medical diagnosis and terminology in the course of covering the foregoing. Offered as EECS 480B and EBME 480B.

EECS 480C. Biomedical Sensing Instrumentation. 3 Units.
Study of principles, applications, and design of biomedical instruments with special emphasis on transducers. Understanding of basic sensors, amplifiers, and signal processing. Discussion of the origin of biopotential, and biopotential electrodes and amplifiers (including biotelemetry). Understanding of chemical sensors and clinical laboratory instrumentation, including microfluidics. Offered as EECS 480C and EBME 480C. Prereq: EECS/EBME 480A, EECS/EBME 480B

EECS 480D. The Health Care Delivery Ecosystem. 3 Units.
Health care delivery across the continuum of care in the United States, including health policy and reform, financing of care, comparative health systems, population health, public health, access to care, care models, cost and value, comparative effectiveness, governance, management, accountability, workforce, and the future. Discussions of opportunities and challenges for wireless health, integrated into the foregoing topics. Perspective on health care delivery in other countries. Offered as EECS 480D and EBME 480D.

EECS 480E. Wireless Communications and Networking. 3 Units.
Essentials of wireless communications and networking, including teletraffic engineering, radio propagation, digital and cellular communications, wireless wide-area network architecture, speech and channel coding, modulation schemes, antennas, security, networking and transport layers, and 4G systems. Hands-on learning of the anatomy of a cell phone, and a paired wireless health device and its gateway. Offered as EECS 480E and EBME 480E.

EECS 480F. Physicians, Hospitals and Clinics. 3 Units.
Rotation through one or more health care provider facilities for a first-hand understanding of care delivery practice, coordination, and management issues. First-hand exposure to clinical personnel, patients, medical devices and instruments, and organizational workflow. Familiarity with provider protocols, physician referral practices, electronic records, clinical decision support systems, acute and chronic care, and inpatient and ambulatory care. Offered as EECS 480F and EBME 480F.

EECS 480G. Applied Cryptography. 3 Units.
This course begins with a discussion of how mobility-driven computing and communication systems use cryptography to protect data and protocols. The foundation for critical cryptographic concepts, techniques, and algorithms are covered. The fundamental cryptographic concepts are studied, including: symmetric encryption, public key encryption, digital signatures, cryptographic hash function, and message authentication codes; cryptographic protocols, such as key exchange, remote user authentication, and interactive proofs; cryptanalysis of cryptographic primitives and protocols, such as by side-channel attacks, differential cryptanalysis, or replay attacks; and cryptanalytic techniques on deployed systems, such as memory remanence, timing attacks, fault attacks, and differential power analysis. Techniques used for code making (cryptographic) and break codes (cryptanalytic) are covered, as well as how these techniques are used within larger security systems.

EECS 480H. Software Security. 3 Units.
This course begins with discussions of good software engineering practices to ensure security in modern software systems and additional challenges to security due to code mobility in software for mobility-driven computing. The basics of software security and threat models, methods to protect software (operating systems, databases, distributed software) - including risk analysis, authentication and authorization, access control, and software architecture for security - are studied. Principles of secure coding, validation and verification of secure software, software and data watermarking, code obfuscation, tamper resistant software are studied, as well as the benefits of open source and closed source software. Use of software as an attack mechanism and emerging attack models (including joint hardware-software attacks) are studied.

EECS 480I. Hardware Security. 3 Units.
This course begins with the keys to enabling secure, trustworthy operation of computer hardware - understanding security issues and how appropriate security measures are included during design, verification, test, and deployment. Increasingly the security primitives such as the Trusted Computing Module are being introduced at the hardware level to prevent the compromise of security in systems being deployed today. A comprehensive coverage of security issues in computer hardware is provided. Topics of embedded systems security, hardware Trojans, security in implantable medical devices, security in RFID/NFC, protection from side channel attacks, tamper resistance and crypto processor design, trusted FPGA design/JTAG, hardware-based cryptanalysis, and hardware IP protection against piracy and reverse-engineering are covered. A course project (Can you Hack It?) that challenges students to hack a hardware is included.

EECS 480M. Introduction to Medical Informatics. 3 Units.
Current state and emerging trends in Medical Informatics (MI) and associated health information systems. Principles, data, data management, system interoperability, patient privacy, information security, electronic records, telehealth, regulatory issues, clinical decision support, mobile documentation, devices and wireless communications in healthcare. Impact of wireless technology on emerging health information systems and processes. Offered as EECS 480M and EBME 480M.
EECS 480O. Introduction to Health Information Technology Implementation. 3 Units.
Current state and emerging trends in the implementation and adoption of health information technology (HIT). Macroergonomics; Technology transfer and adoption; Systems adoption life cycle; Impact of regulation; Decision and work transformation; HIT specification and acquisition; Contracting issues; Implementation, use, and evaluation; Impact of wireless technology on emerging processes. Offered as EECS 480O and EBME 480O. Prereq: EECS 480M.

EECS 480P. Advanced Biomedical Instrumentation. 3 Units.
Analysis and design of biosensors in the context of biomedical measurements. Base sensors using electrochemical, optical, piezoelectric, and other principles. Binding equilibria, enzyme kinetics, and mass transport modalities. Adding the "bio" element to base sensors and mathematical aspects of data evaluation. Applications to clinical problems and biomedical research. Offered as EECS 480P and EBME 480P.

EECS 480Q. Regulatory Policy and Regulations. 3 Units.
Introduction of wireless health technologies: spectrum, licensed versus unlicensed; personal area networks; body area networks; ultra-wideband low energy level short-range radios; wireless local area networks; wide area networks. The Federal system: separation of powers; the executive branch and its departments; the House of Representatives and its committees; the Senate and its committees; the FCC; policy versus regulatory versus legislative. What is a medical device: FDA; classification system; radiation-emitting products; software; RF in medical devices; converged medical devices; international aspects. Regulation of health information technology and wireless health: American Recovery and Reinvestment Act; Patient Protection and Affordable Care Act; FCC/FDA MoU; CMS and Reimbursement; privacy and security. Offered as EECS 480Q and EBME 480Q.

EECS 480R. User Experience Engineering. 3 Units.
Social, cognitive, behavioral, and contextual elements in the design of healthcare technology and systems. User-centered design paradigm from a broad perspective, exploring dimensions of product user experience and learning to assess and modify the design of healthcare technology. Practical utilization of user centered design method and assessment techniques for approaching a design problem. Offered as EECS 480R and EBME 480R.

EECS 480S. Wireless Health Product Development. 3 Units.
Integrating application requirements, market data, concept formulation, design innovation, and manufacturing resources for creating differentiated wireless health products that delight the user. Learning user-centric product development best practices, safety, security and privacy considerations, and risk management planning. Understanding the regulatory process. Identifying and managing product development tradeoffs. Offered as EECS 480S and EBME 480S. Prereq: EECS 480R.

EECS 480T. Wearable Computing Design. 3 Units.
Learning about wearable devices using flexible/conformal electronics designed for convenience and uninterrupted wear-ability. Examining related design challenges from the technology, human and business points of view. Understanding wearable product design for general and special-purpose tasks in information processing, media operations, and information extraction from sensed data. Learning about the technological challenges for design, including miniaturization, power delivery and management, data storage, and wireless networking. Learning about hardware choices (processor, field programmable gate array or custom ASIC based design) for wearable computers and software architectures for smart data processing. Learning about wearable designs centered on the human experience, including sensing and interfacing with the human body, as well as user interaction, convenience, and support for non-intrusive social appearance. Case studies tying the business requirements with the technology and design issues.

EECS 480U. Wearable Computing Technology. 3 Units.
Learning about a broad range of cutting-edge technologies suitable for wearable computing. Understanding printed and flexible electronics technologies required for creating wearable computing, in particular organics for active components due to their flexibility or conformity. Examine the tradeoffs between flexible/conformal versus rigid electronics in the context of wearable computing. Reviewing the history of printed electronics used as conductors for membrane keypads, car windscreen heaters and RFID tag antennas—to name a few application examples. Reviewing the latest technology advances in functional components such as displays, lighting, transistors (p-type & n-type), memory, batteries, photovoltaics (PV), sensors, and conductors as well as integration/packaging steps. Understanding the market potential of these technologies by reviewing emerging products.

EECS 480W. Wearable Computing Manufacturing. 3 Units.
Learning about the supply chain and manufacturing processes for flexible electronics, sensors, and other technologies contributing to the development of wearable products. Understanding supply chain issues in low mobility materials, multilevel substrates, nanocomposites, materials for low power sensors, and inks suitable for direct printing. Identifying the tradeoffs involved in various manufacturing methods such as roll-to-roll manufacturing a mature coating technology yet to be proven for full device integration. Studying other manufacturing techniques such as plate-to-plate, direct printing, 3D printing, and screening techniques for their applicability to the manufacturing and integration of flexible electronics. Understanding the use of lithography and vapor deposition techniques in the context of flexible electronics. Examining the issues of systems integration and packaging of the manufactured products.

EECS 480X. Mobility-Driven Computing. 3 Units.
Fundamental concepts in computing and architecture for mobile devices, mobile operating systems, mobility and mobile data management. Application of technologies for location awareness, context awareness, integrated sensors, mobile Internet, displays, pattern recognition and natural language processing, and touch/gesture based user interaction. Understanding of the tradeoffs in design (smartphones, tablets) due to resource constraints such as wireless connectivity, application processing, power management, and graphics. Integration of near- and wide-area wireless communication technologies (Bluetooth, Wireless WAN). Exploration of emerging technologies and services for the mobile platform. Integration of the foregoing concepts in a specific mobile context application (home/office, pedestrian, vehicular).
EECS 480Y. Mobility-Driven Embedded Systems. 3 Units.
Foundations of reliable, energy-efficient and secure design of embedded systems. Fundamentals of mobility in embedded systems including wireless technology, location awareness, sensors, and actuators. Design consideration for processors, DSP, memory, and interfaces under mobility constraints (connectivity, power, and data management). Systems software for embedded computing, device management, and real-time I/O. Software design under constraints of size, performance, availability, and reliability. Software development techniques and practices (compilers, OS, and runtime systems). Case studies of mobility driven real-time embedded systems and software. Applications of mobility driven embedded systems, for example in in biomedical implant systems.

EECS 480Z. Mobile Applications Development. 3 Units.
Understanding of the mobile application architecture, operating systems, and platforms. Challenges and opportunities in mobile application development. Evaluation of the leading mobile platform frameworks with respect to their features, functions, libraries, support, and ease of development. Software design for mobile applications in gaming, multimedia, entertainment, and enterprise applications. Development of enhanced user experience in a multi-touch, multi-sensor (accelerometer, gyroscopes, camera, geo-location) environment. Understanding of software development environments and testing tools, and use of wireless connectivity and data in mobile applications. Development of or extension of a modest application based on a major mobile platforms (iOS, Windows Phone 7, or Android).

EECS 484. Computational Intelligence I: Basic Principles. 3 Units.
This course is concerned with learning the fundamentals of a number of computational methodologies which are used in adaptive parallel distributed information processing. Such methodologies include neural net computing, evolutionary programming, genetic algorithms, fuzzy set theory, and "artificial life." These computational paradigms complement and supplement the traditional practices of pattern recognition and artificial intelligence. Functionalities covered include self-organization, learning a model or supervised learning, optimization, and memorization.

EECS 485. VLSI Systems. 3 Units.
Basic MOSFET models, inverters, steering logic, the silicon gate, nMOS process, design rules, basic design structures (e.g., NAND and NOR gates, PLA, ROM, RAM), design methodology and tools (spice, N.mpc, Caesar, mkpla), VLSI technology and system architecture. Requires project and student presentation, laboratory.

EECS 488. Embedded Systems Design. 3 Units.
Objective: to introduce and expose the student to methodologies for systematic design of embedded system. The topics include, but are not limited to, system specification, architecture modeling, component partitioning, estimation metrics, hardware software codesign, diagnostics.

EECS 489. Robotics I. 3 Units.

EECS 490. Digital Image Processing. 3 Units.
digital images are introduced as two-dimensional sampled arrays of data. The course begins with one-to-one operations such as image addition and subtraction and image descriptors such as the histogram. Basic filters such as the gradient and Laplacian in the spatial domain are used to enhance images. The 2-D Fourier transform is introduced and frequency domain operations such as high and low-pass filtering are developed. It is shown how filtering techniques can be used to remove noise and other image degradation. The different methods of representing color images are described and fundamental concepts of color image transformations and color image processing are developed. One or more advanced topics such as wavelets, image compression, and pattern recognition will be covered as time permits. Programming assignments using software such as MATLAB will illustrate the application and implementation of digital image processing.

EECS 491. Artificial Intelligence: Probabilistic Graphical Models. 3 Units.
This course is a graduate-level introduction to Artificial Intelligence (AI), the discipline of designing intelligent systems, and focuses on probabilistic graphical models. These models can be applied to a wide variety of settings from data analysis to machine learning to robotics. The models allow intelligent systems to represent uncertainties in an environment or problem space in a compact way and reason intelligently in a way that makes optimal use of available information and time. The course covers directed and undirected probabilistic graphical models, latent variable models, associated exact and approximate inference algorithms, and learning in both discrete and continuous problem spaces. Practical applications are covered throughout the course. Prereq: EECS 391 or requisites not met permission.

EECS 493. Software Engineering. 3 Units.
Topics: Introduction to software engineering; software lifecycle models; development team organization and project management; requirements analysis and specification techniques; software design techniques; programming practices; software validation techniques; software maintenance practices; software engineering ethics. Undergraduates work in teams to complete a significant software development project. Graduate students are required to complete a research project. Offered as EECS 393, EECS 393N, and EECS 493. Counts as SAGES Senior Capstone.

EECS 494. Introduction to Information Theory. 3 Units.
This course is intended as an introduction to information and coding theory with emphasis on the mathematical aspects. It is suitable for advanced undergraduate and graduate students in mathematics, applied mathematics, statistics, physics, computer science and electrical engineering. Course content: Information measures-entropy, relative entropy, mutual information, and their properties. Typical sets and sequences, asymptotic equipartition property, data compression. Channel coding and capacity: channel coding theorem. Differential entropy, Gaussian channel, Shannon-Nyquist theorem. Information theory inequalities (400 level). Additional topics, which may include compressed sensing and elements of quantum information theory. Recommended preparation: MATH 201 or MATH 307. Offered as MATH 394, EECS 394, MATH 494 and EECS 494.
EECS 495. Nanometer VLSI Design. 3 Units.
Semiconductor industry has evolved rapidly over the past four decades to meet the increasing demand on computing power by continuous miniaturization of devices. Now we are in the nanometer technology regime with the device dimensions scaled below 100nm. VLSI design using nanometer technologies involves some major challenges. This course will explain all the major challenges associated with nanoscale VLSI design such as dynamic and leakage power, parameter variations, reliability and robustness. The course will present modeling and analysis techniques for timing, power and noise in nanometer era. Finally, the course will cover the circuit/architecture level design solutions for low power, high-performance, testable and robust VLSI system. The techniques will be applicable to design of microprocessor, digital signal processor (DSP) as well as application specific integrated circuits (ASIC). The course includes a project which requires the student to work on a nanometer design issue. Recommended preparation: EECS 426 or EECS 485.

EECS 496. Artificial Intelligence: Sequential Decision Making. 3 Units.
This course will study the formulation and solution of decision making problems by automated agents. Topics covered include one-shot decision making (decision trees and influence diagrams), Markov decision processes (MDPs), automated classical and probabilistic planning, reinforcement learning (RL), hierarchical planning and RL, partially observable MDPs, Bayesian RL, collaborative multi-agent systems. Recommended preparation: EECS 491 (Probabilistic Graphical Models). Prereq: EECS 391.

EECS 497. Artificial Intelligence: Statistical Natural Language Processing. 3 Units.
This course gives students an overview of the state of the art in natural language processing. We will discuss computational aspects of language modeling through probabilistic models, computational approaches to syntax (parsing) and semantic representations, discourse and dialog. We will study the applications of these techniques to a variety of problems including information extraction, translation and summarization. At the end of the course a student should be able to (i) understand the various statistical models and algorithms for NLP (ii) modify them as needed or design novel approaches for specific NLP tasks and (iii) understand how to evaluate the performance of these models and compare them to alternatives. Prereq: EECS 440.

EECS 499. Algorithmic Robotics. 3 Units.
This course introduces basic algorithmic techniques in robotic perception and planning. Course is divided into two parts. The first part introduces probabilistic modeling of robotic motion and sensing, Gaussian and nonparametric filters, and algorithms for mobile robot localization. The second part introduces fundamental deterministic and randomized algorithms for motion planning. Prereq: EECS 426.

EECS 500. EECS Colloquium. 0 Unit.
Seminars on current topics in Electrical Engineering and Computer Science.

EECS 500T. Graduate Teaching II. 0 Unit.
This course provides the Ph.D. candidate with experience in teaching undergraduate or graduate students. The experience is expected to involve direct student contact but will be based upon the specific departmental needs and teaching obligations. This teaching experience will be conducted under the supervision of the faculty member who is responsible for the course, but the academic advisor will assess the educational plan to ensure that it provides an educational experience for the student. Students in this course may be expected to perform one or more of the following teaching related activities: grading homeworks, quizzes, and exams, having office hours for students, running recitation sessions, providing laboratory assistance. Recommended preparation: Ph.D. student in EECS department.

EECS 516. Large Scale Optimization. 3 Units.
Concepts and techniques for dealing with large optimization problems encountered in designing large engineering structure, control of interconnected systems, pattern recognition, and planning and operations of complex systems; partitioning, relaxation, restriction, decomposition, approximation, and other problem simplification devices; specific algorithms; potential use of parallel and symbolic computation; student seminars and projects. Recommended preparation: EECS 416.

EECS 520. Robust Control. 3 Units.
One of the most important problems in modern control theory is that of controlling the output of a system so as to achieve asymptotic tracking of prescribed signals and/or asymptotic rejection of undesired disturbances. The problem can be solved by the so-called regulator theory and H-infinity control theory. This course presents a self-contained introduction to these two important design methods. The intention of this course is to present ideas and methods on such a level that the beginning graduate student will be able to follow current research. Both linear and nonlinear results will be covered. Recommended preparation: EECS 408.

EECS 523. Advanced Neural Microsystems. 3 Units.
This course will cover the latest advances in neuroengineering with specific attention to integrated microsystems targeting wired/wireless multichannel interfacing with the nervous system at the cellular level in biological hosts. The aim is to provide students familiar with microfabrication and integrated circuit design with an application-driven, system-level overview of sensors and microelectronics in microsystems format for neural engineering. Recommended preparation: EECS 408.

EECS 526. Integrated Mixed-Signal Systems. 3 Units.
Mixed-signal (analog/digital) integrated circuit design. D-to-A and A-to-D conversion, applications in mixed-signal VLSI, low-noise and low-power techniques, and communication sub-circuits. System simulation at the transistor and behavioral levels using SPICE. Class will design a mixed-signal CMOS IC for fabrication by MOSIS. Recommended preparation: EECS 426.

EECS 527. Advanced Sensors: Theory and Techniques. 3 Units.
Sensor technology with a primary focus on semiconductor-based devices. Physical principles of energy conversion devices (sensors) with a review of relevant fundamentals: elasticity theory, fluid mechanics, silicon fabrication and micromachining technology, semiconductor device physics. Classification and terminology of sensors, defining and measuring sensor characteristics and performance, effect of the environment on sensors, predicting and controlling sensor error. Mechanical, acoustic, magnetic, thermal, radiation, chemical and biological sensors will be examined. Sensor packaging and sensor interface circuitry.
EECS 531. Computer Vision. 3 Units.
The goal of computer vision is to create visual systems that recognize objects and recover structures in complex 3D scenes. This course emphasizes both the science behind our understanding of the fundamental problems in vision and the engineering that develops mathematical models and inference algorithms to solve these problems. Specific topics include feature detection, matching, and classification; visual representations and dimensionality reduction; motion detection and optical flow; image segmentation; depth perception, multi-view geometry, and 3D reconstruction; shape and surface perception; visual scene analysis and object recognition.

EECS 589. Robotics II. 3 Units.
Survey of research issues in robotics. Force control, visual servoing, robot autonomy, on-line planning, high-speed control, man/machine interfaces, robot learning, sensory processing for real-time control. Primarily a project-based lab course in which students design real-time software executing on multi-processors to control an industrial robot. Recommended preparation: EECS 489.

EECS 600. Special Topics. 1 - 18 Units.
Offered as EECS 600 and SYBB 600.

EECS 600T. Graduate Teaching III. 0 Unit.
This course will provide Ph.D. candidate with experience in teaching undergraduate or graduate students. The experience is expected to involve direct student contact but will be based upon the specific departmental needs and teaching obligations. This teaching experience will be conducted under the supervision of the faculty member who is responsible for the course, but the academic advisor will assess the educational plan to ensure that it provides an educational experience for the student. Students in this course may be expected to perform one or more of the following teaching related activities running recitation sessions, providing laboratory assistance, developing teaching or lecture materials presenting lectures. Recommended preparation: Ph.D. student in EECS department.

EECS 601. Independent Study. 1 - 18 Units.
EECS 620. Special Topics. 1 - 18 Units.
EECS 621. Special Projects. 1 - 18 Units.
EECS 649. Project M.S.. 1 - 9 Units.
EECS 651. Thesis M.S.. 1 - 18 Units.
EECS 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Electrical, Computer, and Systems Engineering Division
Marc Buchner, PhD
(Michigan State University)
Associate Professor
Computer gaming and simulation, virtual reality, software-defined radio, wavelets, joint time-frequency analysis

Vira Chankong, PhD
(Case Western Reserve University)
Associate Professor
Large-scale optimization; logic-based optimization; multi-objective optimization; optimization applications in radiation therapy treatment planning, medical imaging, manufacturing and production systems, and engineering design problems

Philip Feng, PhD
(California Institute of Technology)
Associate Professor
Nanoelectromechanical systems (NEMS), energy-efficient devices, advanced materials & devices engineering, bio/chemical sensors & biomedical microsystems, RF/microwave devices & circuits, low-noise measurement & precision instruments

Michael Fu, PhD
(Case Western Reserve University)
Assistant Professor
Neuro-rehabilitation and motor-relearning, with emphasis on virtual environments, neuromuscular electrical stimulation, robotics, psychophysics, haptic interfaces, and brain-machine interfaces

Roberto Fernandez Galan, PhD
(Humboldt Universität)
Assistant Professor
Systems Biology, Signal Processing and Data Analysis, Computational Neuroscience and Electrophysiology

Mario Garcia-Sanz, DrEng
(University of Navarra, Spain)
Professor
Robust and nonlinear control, quantitative feedback theory, multivariable control, dynamic systems, systems modeling and identification; energy innovation, wind energy, spacecraft, electrical, mechanical, environmental and industrial applications

Evren Gurkan-Cavusoglu, PhD
(Middle East Technical University)
Assistant Professor
Power systems, electricity markets, operation research, optimization, smart grid

Ming-Chun Huang, PhD
(University of California, Los Angeles)
Assistant Professor
Health Informatics, HCI, Visualization

Richard Kolacinski, Ph.D.
(Case Western Reserve University)
Assistant Professor
Controls, Complex Systems
Gregory S. Lee, PhD
(University of Washington)
Assistant Professor
Haptic devices, including low-power design and effects on perception; applications to robotic surgery and telesurgery; secure teleoperation

Pan Li, PhD
(University of Florida)
Associate Professor
Networks, Cybersecurity, Big data, Cyber-phsyical systems, Bioinformatics

Wei Lin, PhD
(Washington University in St. Louis)
Professor
Nonlinear control, dynamic systems and homogeneous systems theory, H-inf/m/ control and robust control, adaptive control, system parameter estimation and fault detection, nonlinear control applications to under-actuated mechanical systems, biologically-inspired systems and biology

Kenneth A. Loparo, PhD
(Case Western Reserve University)
Nord Professor of Engineering
Stability and control of nonlinear and stochastic systems; fault detection, diagnosis, and prognosis; recent applications work in advanced control and failure detection of rotating machines, signal processing for the monitoring and diagnostics of physiological systems, and modeling, analysis, and control of power and energy systems

Behnam Malakooti, PhD, PE
(Purdue University)
Professor
Design and multi-objective optimization, manufacturing/production/operations systems, intelligent systems and networks, artificial neural networks, biological systems, intelligent decision making

Soumyajit Mandal, PhD
(Massachusetts Institute of Technology)
Assistant Professor
Integrated Circuits and Systems, Nuclear Magnetic Resonance (NMR) Sensors

Mehran Mehregany, PhD
(Massachusetts Institute of Technology)
Goodrich Professor of Engineering Innovation
Research and development at the intersections of micro/nano-electro-mechanical systems, semiconductor silicon carbide and integrated circuits

Pedram Mohseni, PhD
(University of Michigan)
Professor
Biomedical microsystems, bioelectronics, wireless neural interfaces, CMOS interface circuits for MEMS, low-power wireless sensing/actuating microsystems

Wyatt S. Newman, PhD, PE
(Massachusetts Institute of Technology)
Professor
Mechatronics, high-speed robot design, force- and vision-based machine control, artificial reflexes for autonomous machines, rapid prototyping, agile manufacturing, mobile robotic platforms

Christos Papachristou, PhD
(Johns Hopkins University)
Professor
VLSI design and CAD, computer architecture and parallel processing, design automation, embedded system design

Marija Prica, PhD
(Carnegie Mellon University)
Assistant Professor
Energy, Optimization, Protection

Daniel Saab, PhD
(University of Illinois at Urbana-Champaign)
Associate Professor
Computer architecture, VLSI system design and test, CAD design automation

Sree N. Sreenath, PhD
(University of Maryland)
Professor
Systems biology complexity research (modeling, structural issues, and simulation); cell signaling, population behavior, and large-scale behavior; global issues and sustainable development

Christian A. Zorman, PhD
(Case Western Reserve University)
Professor
Materials and processing techniques for MEMS and NEMS, wide bandgap semiconductors, development of materials and fabrication techniques for polymer-based MEMS and bioMEMS

Computer Science Division

Harold S. Connamacher, PhD
(University of Toronto)
Assistant Professor
Constraint satisfaction problems, graph theory, random structures, and algorithms

Chris Fietkiewicz, PhD
(Case Western Reserve University)
Assistant Professor
Applied and theoretical neuroscience, neuronal modeling, signal processing and signal analysis, electrophysiology, applications to epilepsy and respiratory control

Mehmet Koyuturk, PhD
(Purdue University)
T&D Schroeder
Bioinformatics and computational biology, computational modeling and algorithm development for systems biology, integration, mining and analysis of biological data, algorithms for distributed systems

Michael Lewicki, PhD
(California Institute of Technology)
Professor
Computational perception and scene analysis, visual representation and processing, auditory representation and analysis
Jing Li, PhD  
(University of California, Riverside)  
Professor  
Computational biology and bioinformatics, statistical genomics and functional genomics, systems biology, algorithms

Vincenzo Liberatore, PhD  
(Rutgers University)  
Associate Professor  
Distributed systems, Internet computing, randomized algorithms

H. Andy Podgurski, PhD  
(University of Massachusetts, Amherst)  
Professor  
Software engineering methodology and tools, especially use of data mining, machine learning, and program analysis techniques in software testing, fault detection and localization, reliable engineering and software security, electronic mediadicl records, privacy

Michael Rabinovich, PhD  
(University of Washington)  
Professor  
Computer networks, Internet performance evaluation, databases, utility computing

Soumya Ray, PhD  
(University of Wisconsin, Madison)  
Associate Professor  
Artificial intelligence, machine learning, reinforcement learning, automated planning, applications to interdisciplinary problems including medicine and bioinformatics

Xusheng Xiao, PhD  
(North Carolina State University)  
Assistant Professor  
Software Engineering, Computer Security

Francis "Frank" L. Merat, PhD, PE  
(Case Western Reserve University)  
Emeritus Professor  
Computer and robot vision, digital image processing, sensors, titanium capacitors and power electronics; RF and wireless systems; optical sensors; engineering education

Gultekin Ozsoyoglu, PhD  
(University of Alberta, Canada)  
Emeritus Professor  
Graph databases and data mining problems in metabolic networks, metabolomics, and systems biology, bioinformatics, web data mining

Z. Meral Ozsoyoglu, PhD  
(University of Alberta, Canada)  
Emeritus Professor  
Database systems, database query languages and optimization, data models, index structures, bioinformatics, medical informatics

Adjunct Faculty Appointments

Michael Adams, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor

Mark A. Allman, MSEE  
(Ohio University)  
Adjunct Instructor

Mahdi Cheraghchi Bashi Astaneh, Ph.D.  
(Swiss Federal Institute of Technology)  
Adjunct Assistant Professor

Nicholas Barendt, MSEE  
(Case Western Reserve University)  
Adjunct Sr. Instructor

Gurkan Bebek, Ph.D.  
(Case Western Reserve University)  
Adjunct Instructor

Swarup Bhunia, Ph.D.  
(Purdue University)  
Adjunct Associate Professor

Michael S. Branicky, ScD, PE  
(Massachusetts Institute of Technology)  
Adjunct Professor

Lev Gonick, Ph.D.  
(York University, Toronto)  
Adjunct Professor

John C. Hoag, Ph.D.  
(The Ohio State University)  
Adjunct Associate Professor
The Engineering Physics major allows students with strong interests in both physics and engineering to concentrate their studies in the common areas of these disciplines. The Engineering Physics major prepares students to pursue careers in industry, either directly after undergraduate studies, or following graduate study in engineering or physics. Many employers value the unique problem solving approach of physics, especially in industrial research and development. Its engineering science and design components prepare students to work as professional engineers.
Students majoring in engineering physics complete the Engineering Core as well as a rigorous course of study in physics. Students select a concentration area from an engineering discipline, and must complete a sequence of at least four courses in this discipline. In addition, a senior research project under the guidance of a faculty member is required. The project includes a written report and participation in the senior seminar and symposium.

Mission
The mission of the Engineering Physics program is to prepare students for careers in engineering where physics principles can be applied to the advancement of technology. This education at the intersection of engineering and physics will enable students to seek employment in engineering upon graduation while providing a firm foundation for the pursuit of graduate studies in either engineering or physics. The Engineering Physics program will develop sufficient depth in both engineering and physics skills to produce engineers who can relate fundamental physics to practical engineering problems, and will possess the versatility to address new problems in our rapidly changing technological base. The program will provide a curriculum and environment to develop interdisciplinary collaboration, ethical and professional outlooks, communication skills, and the tools and desire for life-long learning.

Program Educational Objectives
1. Graduates of the Engineering Physics program will apply their strong problem solving skills as physicists along with an understanding of the approach, methods, and requirements of engineering and engineering design for a successful career in advancing technology.
2. Graduates of the Engineering Physics program will use their strong skills in problem solving, research experience and knowledge in physics and engineering as successful graduate students and researchers in highly ranked graduate programs.

Student Outcomes
As preparation for achieving the above program educational objectives, the BS degree program in Engineering Physics is designed so that students attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The Bachelor of Science degree program in Engineering Physics is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

Bachelor of Science in Engineering
Required Courses: Major in Engineering Physics
In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

Major Required Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 208</td>
<td>Instrumentation and Signal Analysis Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 310</td>
<td>Classical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 313</td>
<td>Thermodynamics and Statistical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 317</td>
<td>Engineering Physics Laboratory I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 318</td>
<td>Engineering Physics Laboratory II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 324</td>
<td>Electricity and Magnetism I</td>
<td>3</td>
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<td>PHYS 325</td>
<td>Electricity and Magnetism II</td>
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<tr>
<td>PHYS 331</td>
<td>Introduction to Quantum Mechanics I</td>
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<td>PHYS 352</td>
<td>Senior Physics Project Seminar a</td>
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<td>PHYS 353</td>
<td>Senior Engineering Physics Project a</td>
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Breadth Elective Sequence

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>EECS 321</td>
<td>Semiconductor Electronic Devices</td>
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</tr>
<tr>
<td>EMSE 405</td>
<td>Dielectric and Electrical Properties of Materials</td>
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<tr>
<td>PHYS 315</td>
<td>Introduction to Solid State Physics</td>
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<tr>
<td>PHYS 327</td>
<td>Laser Physics</td>
<td></td>
</tr>
<tr>
<td>PHYS 332</td>
<td>Introduction to Quantum Mechanics II</td>
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</tbody>
</table>

The Bachelor of Arts degree program in Engineering Physics is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

Required Courses: Engineering Physics Concentration

Engineering Physics majors must complete a sequence of at least four upper level courses in an engineering concentration. Students should seek advice from those engineering representatives listed below to select the courses consistent with scheduling, student preparation, and student interest. Both the program representative and the student's adviser must approve the sequence. Following approval, students must submit the paperwork to undergraduate studies to insure credit for the sequence toward graduation.
### Bachelor of Science in Engineering

**Suggested Program of Study: Major in Engineering Physics**

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

#### First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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#### Second Year

<table>
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#### Third Year

<table>
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#### Fourth Year

<table>
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<th>Units</th>
<th>Fall</th>
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<tbody>
<tr>
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<tr>
<td>15</td>
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</tr>
</tbody>
</table>

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* University general education requirement
** Engineering general education requirement
a Selected students may be invited to take MATH 124 Calculus II, MATH 227 Calculus III or MATH 228 Differential Equations in place of MATH 121 Calculus for Science and Engineering I, MATH 122 Calculus for Science and Engineering II, MATH 223 Calculus for Science and Engineering III or MATH 224 Elementary Differential Equations.
b Selected students may be invited to take PHYS 123 Physics and Frontiers I - Mechanics or PHYS 124 Physics and Frontiers II - Electricity and Magnetism in place of PHYS 121 General Physics I - Mechanics or PHYS 122 General Physics II - Electricity and Magnetism.
c Students may also choose to fulfill this requirement with EECS 132 Introduction to Programming in Java.
Engineering Physics Concentration courses are flexible, but must be in a specific engineering discipline or study area and be approved by an advisor. Possible concentration areas include: Biomedical Engineering (Biomedical Systems and Analysis, Devices and Instrumentation, Biomaterials); Chemical Engineering; Civil Engineering (Solid Mechanics, Structural Engineering, Geotechnical Engineering, Environmental Engineering); Electrical Engineering and Computer Science (Solid State, Computer Science, Computer Engineering-Software, Computer Engineering-Hardware, Systems and Control); Macromolecular Science and Engineering; Materials Science and Engineering; Mechanical and Aerospace Engineering (Aerospace, Mechanics).

Students may choose to fulfill this requirement in their third year:
- PHYS 315 Introduction to Solid State Physics
- PHYS 332 Introduction to Quantum Mechanics II
- PHYS 327 Laser Physics/PHYS 427 Laser Physics
- EECS 321 Semiconductor Electronic Devices
- EMSE 405 Dielectric and Electrical Properties of Materials

Research
The research activities of the department span the entire scope of macromolecular science and polymer technology.

Synthesis
New types of macromolecules are being made in the department's synthesis laboratories. The emphasis is on creating polymers with novel functional properties such as photoconductivity, selective permeation, and biocompatibility, and in producing new materials which behave like classical polymers without being linked together by covalent bonds.

Physical Characterization
This is the broad area of polymer analysis, which seeks to relate the structure of the polymer at the molecular level to the bulk properties that determine its actual or potential applications. This includes characterization of polymers by infrared, Raman, and NMR and mass spectroscopy, thermal and rheological analysis, determination of structure and morphology by x-ray diffraction, electron microscopy, and atomic force microscopy, permeability and free volume, and investigation of molecular weights and conformation by light scattering.

Mechanical Behavior and Analysis
Polymeric materials are known for their unusual mechanical capabilities, usually exploited as components of structural systems. Analysis includes the study of viscoelastic behavior, yielding and fracture phenomena and a variety of novel irreversible deformation processes.

Processing
A major concern of industry is the efficient and large scale production of polymer materials for commercial applications. Research in this area is focusing on reactive processing, multi-layer processing and polymer mixing, i.e., compounding and blends. The integration of sensors and processing equipment, and methods for examining changes in structure and composition during processing steps are growing areas of inquiry. Both laboratory and simulation research are brought to bear on these critical issues.

Materials Development and Design
Often, newly conceived products require the development of polymeric materials with certain specific properties or design characteristics. Materials can be tailor-made by designing synthesis and processing conditions to yield the best performance under specified conditions. Examples might be the design of photoluminescent and semi-conducting polymers for use in optoelectronic devices, polymers that are stable at high temperatures for fire-retardant construction materials, high temperature polymer electrolytes for use in advanced fuel cells, low density thermal insulating polymer composite materials, advanced polymeric optical devices, and biocompatible polymers for use in prosthetic implants, reconstructive medicine and drug-delivery vehicles.

Biopolymers
Living systems are composed primarily of macromolecules, and research is in progress on several projects of medical relevance. The department has a long-standing interest in the hierarchical structure and properties of the components of connective tissues (e.g., skin, cartilage, and bone). The department is also engaged in the development of new biocompatible polymers for applications in human health.

Department of Macromolecular Science and Engineering

314 Kent Smith Building (7202)
http://polymers.case.edu
Phone: 216.368.4172; Fax: 216.368.4202
David Schiraldi, Professor and Chair
david.schiraldi@case.edu

Macromolecular science and engineering is the study of the synthesis, structure, processing, and properties of polymers. These giant molecules are the basis of synthetic materials including plastics, fibers, rubber, films, paints, membranes, and adhesives. Research is constantly expanding these applications through the development of new high performance polymers, e.g. for engineering composites, electronic, optical, and biomedical uses. In addition, most biological systems are composed of macromolecules—proteins (e.g. silk, wool, tendon), carbohydrates (e.g. cellulose) and nucleic acids (RNA and DNA) are polymers and are studied by the same methods that are applied to synthetic polymers.

Production of polymers and their components is central to the chemical industry, and statistics show that over 75 percent of all chemists and chemical engineers in industry are involved with some aspect of polymers. Despite this, formal education in this area is offered by only a few universities in this country, resulting in a continued strong demand for our graduates upon completion of their BS, MS, or PhD degrees.

Mission
To educate students who will excel and lead in the development of polymeric materials and the application of structure-property relationships. The department seeks to prepare students for either professional employment or advanced education, primarily in this or related science or engineering disciplines, but also in professional schools of business, law or medicine. Undergraduate students are offered opportunities for significant research experience, capitalizing on the strength of our graduate program.
Undergraduate Programs

In 1970, the department introduced a program leading to the Bachelor of Science in Engineering degree with a major in polymer science, which is designed to prepare the student both for employment in polymer-based industry and for graduate education in polymer science. The Bachelor of Science degree program in Polymer Science and Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

The Case School of Engineering is proud that the polymer science and engineering program was the first such undergraduate program in the country to receive accreditation from the Engineering Council for Professional Development. The curriculum combines courses dealing with all aspects of polymer science and engineering with basic courses in chemistry, physics, mathematics, and biology, depending on the needs and interests of the student. The student chooses a sequence of technical electives, in consultation with a faculty advisor, allowing a degree of specialization in one particular area of interest, e.g., biomaterials, chemical engineering, biochemistry, or physics. In addition to required formal laboratory courses, students are encouraged to participate in the research activities of the department, both through part-time employment as student laboratory technicians and through the senior project requirement: a one or two semester project that involves the planning and performance of a research project.

Polymer science undergraduates are also strongly encouraged to seek summer employment in industrial laboratories during at least one of their three years with the department. In addition to the general undergraduate curriculum in macromolecular science, the department offers three specialized programs which lead to the BS with a macromolecular science major. The cooperative program contains all the course work required for full-time resident students plus one or two six-month cooperative sessions in polymer-based industry. The company is selected by the student in consultation with his or her advisor, depending on the available opportunities. The dual-degree program allows students to work simultaneously on two baccalaureate level degrees within the university. It generally takes five years to complete the course requirements for each department for the degree. The BS/MS program leads to the simultaneous completion of requirements for both the master’s and bachelor’s degrees. Students with a minimum GPA of 3.0 may apply for admission to this program in their junior year.

Program Educational Objectives

This program will produce graduates who:

1. Are competent, creative, and highly valued professionals in industry, academia, or government.
2. Are flexible and adaptable in the workplace, possess the capacity to embrace new opportunities of emerging technologies, and embrace leadership and teamwork opportunities, all affording sustainable engineering careers.
3. Continue their professional development by obtaining advanced degrees in Polymer Science and Engineering or other professional fields, as well as medicine, law, management, finance or public policy.
4. Act with global, ethical, societal, ecological, and commercial awareness expected of practicing engineering professionals.

Student Outcomes

As preparation for achieving the above educational objectives, the BS degree in Polymer Science and Engineering is designed so that students attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs
- an ability to function in multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Bachelor of Science in Engineering

Required Courses: Major in Polymer Science and Engineering

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAC 270</td>
<td>Introduction to Polymer Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 276</td>
<td>Polymer Properties and Design</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 351</td>
<td>Physical Chemistry for Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 352</td>
<td>Polymer Physics and Engineering</td>
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</tr>
<tr>
<td>EMAC 355</td>
<td>Polymer Analysis Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 370</td>
<td>Polymer Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 372</td>
<td>Polymer Processing and Testing Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 375</td>
<td>Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 376</td>
<td>Polymer Engineering</td>
<td>3</td>
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<tr>
<td>EMAC 377</td>
<td>Polymer Processing</td>
<td>3</td>
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<td>EMAC 378</td>
<td>Polymer Engineer Design Product</td>
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</tr>
<tr>
<td>EMAC 398</td>
<td>Polymer Science and Engineering Project I</td>
<td>1 - 3</td>
</tr>
<tr>
<td>3 Technical Electives</td>
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<td>9</td>
</tr>
<tr>
<td>1 Natural Science Elective, chosen in consultation with the student’s academic adviser. These can include a 3 or 6 credit sequence of</td>
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<tr>
<td>EMAC 125/EMAC 325 Undergraduate Research</td>
<td>3-6</td>
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Total Units 46-51
### Biomaterials track

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>EMAC 270</td>
<td>Introduction to Polymer Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 276</td>
<td>Polymer Properties and Design</td>
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</tr>
<tr>
<td>EMAC 351</td>
<td>Physical Chemistry for Engineering</td>
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</tr>
<tr>
<td>EMAC 352</td>
<td>Polymer Physics and Engineering</td>
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</tr>
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<td>EMAC 355</td>
<td>Polymer Analysis Laboratory</td>
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<td>EMAC 370</td>
<td>Polymer Chemistry</td>
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<td>EMAC 376</td>
<td>Polymer Engineering</td>
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<td>EMAC 378</td>
<td>Polymer Engineer Design Product</td>
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<td>EMAC 398</td>
<td>Polymer Science and Engineering Project I</td>
<td>1 - 3</td>
</tr>
<tr>
<td>EBME 201</td>
<td>Physiology-Biophysics I</td>
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<td>EBME 202</td>
<td>Physiology-Biophysics II</td>
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<tr>
<td>EBME 306</td>
<td>Introduction to Biomedical Materials</td>
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1 Natural Science Elective, chosen in consultation with the student's academic adviser.

3 Technical Electives have to be taken from:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>EBME 305</td>
<td>Materials for Prosthetics and Orthotics</td>
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</tr>
<tr>
<td>EBME 316</td>
<td>Biomaterials for Drug Delivery</td>
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</tr>
<tr>
<td>EBME 325</td>
<td>Introduction to Tissue Engineering</td>
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</tr>
<tr>
<td>EBME 350</td>
<td>Quantitative Molecular, Cellular and Tissue Bioengineering</td>
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<tr>
<td>EBME 425</td>
<td>Tissue Engineering and Regenerative Medicine</td>
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<tr>
<td>EBME 426</td>
<td>Nanomedicine</td>
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<td>EBME 406</td>
<td>Polymers in Medicine</td>
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<td>or EMAC 471</td>
<td>Polymers in Medicine</td>
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A three-credit research sequence of

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>EMAC 125</td>
<td>Freshman Research on Polymers (and/or)</td>
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<tr>
<td>EMAC 325</td>
<td>Undergraduate Research in Polymer Science</td>
<td>1 - 3</td>
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</table>

**Total Units: 72-76**

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### Bachelor of Science in Engineering

**Suggested Program of Study: Major in Polymer Science and Engineering**

*(standard track)*

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

#### First Year

<table>
<thead>
<tr>
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<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
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<td>4</td>
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<tr>
<td>Elementary Computer Programming (ENGR 131)**</td>
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<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
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<td>FSCC 100 Sages First Seminar</td>
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#### Second Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>SAGES University Seminar I*</td>
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<td>3</td>
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<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
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<tr>
<td>Calculus for Science and Engineering II (MATH 122)**</td>
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<tr>
<td>General Physics I - Mechanics (PHYS 121)**</td>
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<tr>
<td>PHED Physical Education Activities*</td>
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**Year Total:**

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#### Third Year

<table>
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<tr>
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<tbody>
<tr>
<td>SAGES University Seminar II*</td>
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<tr>
<td>Introductory Organic Chemistry I (CHEM 223)</td>
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<tr>
<td>Introduction to Polymer Science and Engineering (EMAC 270)</td>
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<tr>
<td>Calculus for Science and Engineering III (MATH 223)**</td>
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<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)**</td>
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<td>4</td>
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<tr>
<td>Humanities or Social Science**</td>
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<td>3</td>
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<tr>
<td>Introductory Organic Chemistry II (CHEM 224)</td>
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<td>3</td>
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<tr>
<td>Polymer Properties and Design (EMAC 276) ((SAGES Departmental Seminar))</td>
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<td>3</td>
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<tr>
<td>Statics and Strength of Materials (ENGR 200)**</td>
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<td>3</td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224)**</td>
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**Year Total:**

<table>
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<tr>
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#### Fourth Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)**</td>
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<tr>
<td>Polymer Chemistry (EMAC 370)</td>
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<tr>
<td>Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology (EMAC 375)</td>
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<tr>
<td>Polymer Processing (EMAC 377)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Polymer Science and Engineering Project I (EMAC 398) ((SAGES Capstone Course))</td>
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**Year Total:**

<table>
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<tbody>
<tr>
<td>15</td>
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<td>18</td>
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</table>
Bachelor of Science in Engineering

Suggested Program of Study: Major in Polymer Science and Engineering (biomaterials track)

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Humanities or Social Sciences **</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
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<tr>
<td>Elementary Computer Programming (ENGR 131)**</td>
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<td>Calculus for Science and Engineering I (MATH 121)**</td>
<td>4</td>
<td></td>
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<tr>
<td>FSCE 100 Sages First Seminar</td>
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<td>PHED Physical Education Activities</td>
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<tr>
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<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
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<td>Calculus for Science and Engineering II (MATH 122)**</td>
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<td>General Physics I - Mechanics (PHYS 121)**</td>
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<td>PHED Physical Education Activities</td>
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<tr>
<td>Humanities or Social Sciences **</td>
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<tr>
<td>Introductory Organic Chemistry I (CHEM 223) d</td>
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<tr>
<td>Chemical Laboratory Methods for Engineers (CHEM 290)</td>
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<tr>
<td>Introduction to Biomedical Materials (EBME 306)</td>
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<td>Physical Chemistry for Engineering (EMAC 351)</td>
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<td>Structure of Biological Materials (EMAC 303)</td>
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<th>Spring</th>
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<tbody>
<tr>
<td>Humanities or Social Sciences **</td>
<td>3</td>
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</tr>
<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)**</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td>Polymer Chemistry (EMAC 370)</td>
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<tr>
<td>Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology (EMAC 375)</td>
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<td></td>
<td></td>
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<tr>
<td>Polymer Processing (EMAC 377)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Technical elective II f</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymer Engineer Design Product (EMAC 378)</td>
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<td></td>
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</tr>
<tr>
<td>Polymer Science and Engineering Project I (EMAC 398) (SAGES Capstone Course)** 9</td>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGL 398) &amp; Professional Communication for Engineers (ENGR 398)**</td>
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<tr>
<td>Technical elective III f</td>
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<tr>
<td>Year Total:</td>
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<td>12</td>
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</tbody>
</table>

| Total Units in Sequence: | 125 | | |

Hours required for graduation: 129

* University general education requirement
** Engineering general education requirement
Approved Natural Science electives:
- BIOL 214 Genes, Evolution and Ecology (d);
- BIOL 215 Cells and Proteins (d);
- BIOC 307 Introduction to Biochemistry: From Molecules To Medical Science (d);
- BIOL 362 Principles of Developmental Biology

Suggested for pre-med students
EMAC 355 Polymer Analysis Laboratory is strongly recommended.

Footnote
At least 3 of the 4 Technical Electives have to be taken from:
- EBME 316 Biomaterials for Drug Delivery;
- EBME 325 Introduction to Tissue Engineering;
- EBME 350 Quantitative Molecular, Cellular and Tissue Bioengineering;
- EBME 426 Nanomedicine;
- EMAC 471 Polymers in Medicine / EBME 406 Polymers in Medicine;
- a three-credit research sequence of EMAC 125 Freshman Research on Polymers and EMAC 325 Undergraduate Research in Polymer Science
- EMAC 372 Polymer Processing and Testing Laboratory (offered in the spring semester of the fourth year)
- Other technical electives, as approved by the student’s academic advisor

Preparation for the polymer science project should commence in the previous semester.

Co-op and Internship Programs (http://engineering.case.edu/coop)
Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

Five-Year Combined BS/MS Program
This program offers outstanding undergraduate students the opportunity to obtain an MS degree, with a thesis, in one additional year of study beyond the BS degree (normally, it takes 2 years beyond the BS to earn an MS degree). In this program, an undergraduate student can take up to 9 credit hours that simultaneously satisfy undergraduate and graduate requirements. If the BS part of the BS/MS is in Polymer Science & Engineering, then participating students generally will not take the standard EMAC 401-405 sequence; the additional course work will be taken as electives in this case. Students in this program typically produce a senior thesis during the fall of their fourth year. They then start their research leading to the thesis MS in the spring semester of that year, culminating in a thesis defense spring semester of year five.

Application for admission to the five year BS/MS program is made after completion of five semesters of course work. Minimum requirements are a 3.2 grade point average and the recommendation of a faculty member of the department. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

Year five plan

Spring
Technical Elective 2 (3)
EMAC 651 (6)
EMAC 651 (3)
Thesis defense (typically by mid-March)

Note: A number of 2 credit hour electives are offered each year by the Macro Department, so students may elect to take a sequence of four electives, totaling at least 9 credit hours, in addition to the required 9 hours of EMAC 651 MS Thesis Research.

Minor in Polymer Science and Engineering

The minor in Polymer Science and Engineering consists of five courses from the list below (special arrangements can be made to include appropriate EMAC graduate courses as well).

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAC 270</td>
<td>Introduction to Polymer Science and Engineering</td>
</tr>
<tr>
<td>EMAC 276</td>
<td>Polymer Properties and Design</td>
</tr>
<tr>
<td>EMAC 351</td>
<td>Physical Chemistry for Engineering</td>
</tr>
<tr>
<td>EMAC 355</td>
<td>Polymer Analysis Laboratory</td>
</tr>
<tr>
<td>EMAC 370</td>
<td>Polymer Chemistry</td>
</tr>
<tr>
<td>EMAC 372</td>
<td>Polymer Processing and Testing Laboratory</td>
</tr>
<tr>
<td>EMAC 375</td>
<td>Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology</td>
</tr>
<tr>
<td>EMAC 376</td>
<td>Polymer Engineering</td>
</tr>
<tr>
<td>EMAC 377</td>
<td>Polymer Processing</td>
</tr>
<tr>
<td>EMAC 378</td>
<td>Polymer Engineer Design Product</td>
</tr>
</tbody>
</table>

Total Units: 15

Graduate Programs

Courses leading to the Master of Science (MS) and Doctor of Philosophy (PhD) degrees in macromolecular science are offered within the Case School of Engineering. They are designed to increase the student’s knowledge of macromolecular science and of his or her own basic area of scientific interest, with application to specific polymer research problems. Research programs derive particular benefit from close cooperation with graduate programs in chemistry, physics, materials science, chemical engineering, biological sciences, and other engineering areas. The interdisciplinary academic structure allows the faculty to fit the individual program to the student’s background and career plans. Basic and advanced courses are offered in polymer synthesis, physical chemistry, physics, biopolymers, and applied polymer science and engineering. A laboratory course in polymer characterization instructs students in the use of modern experimental techniques and equipment. Graduate students are also encouraged to take advanced course work in polymer solid state physics, physical chemistry, synthesis, rheology, and polymer processing.
Master of Science

Master’s Thesis (Plan A)
The minimum requirement to complete a master’s degree under Plan A is 27 hours. Of the 27 hours, at least 18 hours must be coursework, and 9 hours must be EMAC 651 Thesis M.S. (thesis research). At least 18 semester hours of coursework, including thesis, must be at the 400 level or higher.

All Plan A MS students must take 6 credits of departmental fundamentals courses including the lab component. Please note: Once a student begins registration of EMAC 651 Thesis M.S., the student must register for at least one credit hour of this course every semester until graduation. The normal residency period for an MS degree is 2 years.

For completion of master’s degree Plan A, an oral examination (defense) of the master’s thesis is required. The examination is conducted by a committee of three university faculty members. The candidate’s thesis advisor usually serves as the chair of the examining committee. The chair of the department or the curricular program faculty appoints members of the committee. The examining committee must agree unanimously that the candidate has passed the thesis examination.

Master’s Comprehensive (Plan B)
The master’s Plan B program is available for individuals who live out-of-state or are working full-time. A research report and oral examination are required before graduation. This option requires 27 total credit hours; categorized by the following:

1. 3-6 cr. hrs. need to be project credit (independent study) which needs to be approved by advisor
2. 21-24 course credits (of which 9 must be based in Macromolecular Science); and
3. 6 core course credits.

Each candidate for the master’s degree under Plan B must satisfactorily pass a comprehensive examination, which is administered by the department or curricular program committee. The examination may be written or oral or both. A student must be registered during the semester in which any part of the comprehensive examination is taken. If not registered for other courses, the student will be required to register for one semester hour of EXAM 600 Master’s Comprehensive Exam, before taking the examination.

Elective and core courses can be taken via Distance Learning (ITN) or by transfer (transfers need to be approved by chair of department and dean of graduate studies; core courses also needs instructors’ approval).

MS Students will generally be required to take the core courses:

EMAC 401 Polymer Foundation Course I: Organic Chemistry 3
EMAC 402 Polymer Foundation Course II: Physical Chemistry 3
EMAC 403 Polymer Foundation Course III: Physics 3
EMAC 404 Polymer Foundation Course IV: Engineering 3

Plus an additional 6 credit hours of coursework for Plan A/15 additional credit hours for Plan B, courses to be approved by his/her adviser.

Master of Science in Macromolecular Science and Engineering with Specialization

Fire Science and Engineering

The Case School of Engineering at Case Western Reserve University offers an MS graduate program in Fire Science and Engineering. Students will choose either a Master of Science in Mechanical Engineering or a Master of Science in Macromolecular Science and Engineering, both with a concentration in fire science. Case Western Reserve offers a unique intersection of expertise in macromolecular and combustion science and mechanical and chemical engineering, making us singularly suited to cover all aspects of fire protection, safety and flammability.

Through a 27-credit-hour curriculum, students explore and learn how to apply the fundamental principles of fire behavior and dynamics, protection and suppression systems, polymeric materials structure, properties and selection and more. The program is designed to be completed in a single 12 month year, but can be spread out over multiple years.

The Fire Science and Engineering program at Case Western Reserve covers all aspects of combustion and fire suppression. After graduating from this degree program, students will be ready to apply their thorough understanding of:

- The chemistry of fire and materials
- Flammability logistics
- Fire dynamics and fire behavior
- Fire risk assessment
- Fire protection engineering
  - Combustion
  - Fire and safety-related codes
  - Human behavior and life safety analysis
  - Structural fire protection
  - Passive fire protection systems
  - Polymer engineering

Elective tracks:
- Mechanical track to focus on mechanical engineering and combustion related to fire protection and suppression
- Materials track to focus on polymer chemistry and materials, and the chemistry of flammability and fire suppression

Degree Options

The Fire Science and Engineering master’s degree program comprises 27 credit hours of classwork (9 courses) and a research paper. Students can choose to receive a Master of Science in Mechanical Engineering with a concentration in Fire Science and Engineering or a Master of Science in Macromolecular Science and Engineering with a concentration in Fire Science and Engineering.

All students will take six core Fire Science and Engineering courses as well as three courses within their chosen elective track of mechanical engineering or macromolecular science and engineering. The mechanical track follows a traditional mechanical engineering/combustion approach to fire protection and suppression, but with specialization classes in polymers. The materials track focuses on polymer chemistry and materials, and the chemistry of flammability and fire suppression.

For additional information, please contact:

David Schiraldi, Chair of the Department of Macromolecular Science and Engineering
The doctoral student is expected to arrange meetings and maintain periodic contact with each committee member. A meeting of the full advisory committee. This committee must be formed within the second semester following admission. Throughout the development and completion of the dissertation, these members are expected to provide constructive criticism and helpful ideas generated by the research problem from the viewpoint of their particular expertise. Each member will make an assessment of the originality of the dissertation, its value, the contribution it makes and the clarity with which concepts are communicated, especially to a person outside the field.

The doctoral student is responsible for becoming sufficiently familiar with the research interests of the department or program faculty to choose in a timely manner a faculty member who will serve as the student’s research advisor. The research advisor is expected to provide mentorship in research conception, methods, performance and ethics, as well as focus on development of the student’s professional communication skills, building professional contacts in the field, and fostering the professional behavior standard of the field and research in general.

The research advisor also assists with the selection of three other faculty to serve as the required additional members of the dissertation advisory committee. This committee must be formed within the second semester following admission. Throughout the development and completion of the dissertation, these members are expected to provide constructive criticism and helpful ideas generated by the research problem from the viewpoint of their particular expertise. Each member will make an assessment of the originality of the dissertation, its value, the contribution it makes and the clarity with which concepts are communicated, especially to a person outside the field.

The doctoral student is expected to arrange meetings and maintain periodic contact with each committee member. A meeting of the full committee for the purpose of assessing the student’s progress should occur at least once a year until the completion of the dissertation.

For students entering the PhD program with an MS degree, 18, instead of 36 credit hours, of coursework is required. Other requirements for a PhD remain the same as described above. Normally students should orient their training around their main area of interest/expertise and in relation to their research program. For those enrolled in the MD/PhD degree program, all 18 course credits for breadth and depth courses must be taken within the Medical School Program.

The core courses designated as depth courses are:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit</th>
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<tbody>
<tr>
<td>EMAC 401</td>
<td>Polymer Foundation Course I: Organic Chemistry</td>
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<tr>
<td>EMAC 402</td>
<td>Polymer Foundation Course II: Physical Chemistry</td>
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<td>EMAC 403</td>
<td>Polymer Foundation Course III: Physics</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 404</td>
<td>Polymer Foundation Course IV: Engineering</td>
<td>3</td>
</tr>
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Students are required to take all four depth courses (12 credits), but on the approval of the instructor, can be excused from one or more of the courses if the relevant course content is not satisfied by a course taken in prior undergraduate or graduate degrees. However, the excused credits must be fulfilled by taking additional breadth courses. NOTE: While EMAC 401 Polymer Foundation Course I: Organic Chemistry and EMAC 402 Polymer Foundation Course II: Physical Chemistry, and EMAC 404 Polymer Foundation Course IV: Engineering are offered at the same time in the Fall and Spring semesters, respectively, students can still sign up for both courses, since one is offered in the first half and the other in the second half of the semester.

Two courses in basic science and/or engineering are required. These courses can be taken in other departments of the School of Engineering, or in the departments of Mathematics, Biology, Biochemistry, Chemistry, or Physics as approved by the advisor.

As part of the course requirements, all students are required to register for EMAC 677 Colloquium in Macromolecular Science and Engineering (the Friday departmental seminars) which will be graded with either “Pass” or “No Pass.”

Students who have taken EMAC 370 Polymer Chemistry and EMAC 376 Polymer Engineering as undergraduates can use these courses to fulfill one or more of the depth requirements in the Department of Macromolecular Science and Engineering for the MS and PhD degree. However, the credits for this course cannot be applied towards the course credit requirements for the graduate degree. Exceptions are possible for the combined BS/MS program.

### Engineering School Requirements

**Depth:** The foundation courses are deemed to satisfy the depth requirements (12 credits).

**Breadth:** Two courses in basic science and/or other departments in the School of Engineering (for a total of six credits). The remaining breadth requirements (18 credits) are satisfied by course modules taken in Macromolecular Science and Engineering.

### Graduate Program Rules

Graduates entering the Department of Macromolecular Science and Engineering are subject to the academic rules of the University, of the
School of Engineering, and of the Department. Consult the Graduate Student Handbook (http://gradstudies.case.edu).

A short abstract of important points include:

1. GPA requirements are described below in the Departmental Rules.
2. A student receiving a “U” in a course is automatically placed on probation and must remove him/herself from probation within one year (usually by repeating the course). If a course is repeated, both original and revised grades will count in the grade point average.
3. Some students are admitted on a probationary basis and must achieve a 3.0 GPA after two semesters to remain in good standing (this is a rule of the Engineering School).
4. Students entering the graduate program for a PhD will need to fill out the “Planned Program of Study” by the end of their second semester.
5. All students are required to serve as teaching assistants. Responsibilities as a TA include serving as an instructor, lab assistant, recitation leader, grader, or tutor in an undergraduate course. After fulfilling the required teaching assistant program, UNIV 400, students will make sure that three teaching courses (400T, 500T, and 600T) are listed on their Planned Program of Study. Completion of this teaching requirement will be monitored by Graduate Studies and is required in order to graduate.

**Engineering School Rules**

Most of these rules are incorporated in the number and type of courses required by the Department. However, Case School of Engineering PhD students are required to 1) maintain full-time status as a PhD bound student; 2) maintain a grade point average of 3.2 or above; and 3) continue making satisfactory academic progress as certified by their advisor.

**Departmental Rules**

1. Students in the PhD program receiving a GPA below 2.50 in any two consecutive semesters will be asked to terminate their graduate study program.
2. The GPA requirement established by the university at various stages of the graduate program shall exclude MS or PhD thesis credits which will be graded “S” or “U” until a final grade is given at the end of the program. Hence a student must maintain a minimum GPA of 2.75 (for an MS) OR a 3.0 (for a PhD) in coursework. (As mentioned above, Case School of Engineering PhD students must maintain a GPA of 3.2 or above.)
3. Plan A MS students must give a departmental seminar (as part of the student lecture series).
4. Plan B MS degrees are limited to non-fellowship students.
5. Coursework may be transferred from another university, subject to Graduate Committee approval if:
   - the courses duplicate requirements of the department;
   - the courses were in excess of the undergraduate degree requirements; or
   - the courses were taken in a graduate program elsewhere;
   - a grade of B or better was achieved in those courses;
   - a petition is made to and approved by the Graduate Committee of the Department
   - the transferred grades will not count in the GPA at CWRU
6. The Department reserves the right to withhold financial support to a student if that student takes an undue amount of time in completing his/her MS or PhD requirements (normally no longer than 3 years for MS and 5 years after initial registration of EMAC 701 Dissertation Ph.D.).
7. A PhD student must pass the written Qualifying Exam within 18 months after enrollment with an MS degree into the PhD program. A PhD student must pass the written Qualifying Exam within 24 months after enrollment with a BS degree into the PhD program. A student only has two chances to pass the Qualifying Exam. Students will be asked to answer 4 mandatory questions – one from each of the following five areas:
   - Polymer Synthesis
   - Polymer Physical Chemistry
   - Polymer Physics
   - Applied Polymer Science
   - Seminars (from the previous year)
   Two elective questions will be chosen from a number of questions from all elective courses offered in the Department. NOTE: The Qualifying Exam is given twice per year respectively on the first Friday in the beginning and the first Friday after the end of the Spring semester. For PhD students enrolled in a Spring semester, those with MS must pass the Qualifying Exam at the end of his/her second Spring semester, and those with BS must pass it at the beginning of his/her third Spring semester.
8. The Research Qualifying Exam (RQE) is designed to test the student’s knowledge of the chosen field as well as his/her originality and ability to perform high quality, independent research. It consists of a written research proposal and an oral defense. All PhD students who hold an MS degree must pass the RQE within 2 years of enrolling in the PhD program, while students with a BS degree must do so within 2.5 years. Successful passing of the Written Qualifying Exam (not to be confused with the written portion of this RQE) is prerequisite to taking the RQE. Students have two chances to pass the RQE and no student will be allowed to continue on to a PhD degree if he/she has not successfully taken it. A conditional pass with major revision (see below) requires modification to the written or oral portion, at the examination committee discretion, within ten business days and following guidelines by the examination committee. A second exam, if required due to failure of the first exam, must be taken within six months of the first exam with at least one examination committee member remaining the same. Passing the exam constitutes advancement to candidacy and is required for enrolling in EMAC 701 Dissertation Ph.D.
9. At least three (3) weeks prior to the RQE oral defense, the student will submit to the graduate chairperson a research proposal title with a one-paragraph synopsis of the research problem and approach, along with suggestions for two members ((i) and (ii), below) of the three member examining committee. The examining committee will consist of three faculty members: (i) a member (or intended member) of the student’s Thesis Advisory Committee, (ii) an expert in the research proposal area and (iii) a faculty member selected systematically and in a neutral manner by the Graduate Committee. The student’s primary thesis advisor or co-advisors is/are excluded from the examining committee. Upon establishing the examining committee, the student will arrange with the committee for the
date, time, and location of the RQE. The student will then distribute the written research proposal to the examining committee five full business days before the defense. It should be no less than 15 and no more than 20 pages of double-spaced text with 1" margins on all sides. No more than 5 pages can be devoted to the proposal introduction or background. Figures, tables, and schemes should not exceed five pages in total. Literature citations are in addition to this page count. The oral presentation will be chaired by a designated chairperson from the examining committee. It should contain only limited background material, focusing primarily on execution of the proposed research. The oral presentation should last 20-30 minutes, with questions from faculty being for clarification only. Following the presentation, the examining committee will ask questions for the student to answer concerning the proposal. On the basis of the written proposal and oral defense (presentation and question responses) the faculty will then confer and tender a decision of pass, conditional pass with major revision, or fail, immediately. The decision will be communicated to the student and graduate chairperson in writing within one business day.

10. All PhD students are required to fulfill their teaching requirement by registering for the three teaching courses, 400T, 500T, and 600T that will be posted to the departmental roster each semester. Completion of the teaching requirement will be monitored by Graduate Studies, and these three teaching courses must appear both on the Program of Study form and the student’s transcript.

11. It is expected that all students will present the results of their research in a Departmental Seminar. This is mandatory for students enrolled in the PhD program. Attendance and registration for these seminars EMAC 677 Colloquium in Macromolecular Science and Engineering. Colloquia Seminars is also mandatory.

12. The department requires the equivalent of six credit hours of departmental assistance. This requirement takes the form of grading, laboratory assistance and/or general departmental duties and is designed to utilize no more than three hours/week of a student's time. The departmental service requirement must be completed within the first two semesters of study. However, the departmental service requirement form must be turned in at the end of the each semester until the obligation is met.

13. Vacation Policy. Graduate students in the department who receive fellowship support for 12 months are normally entitled to two weeks vacation plus national holidays. Alternative arrangements may be made with the student’s advisor, giving ample advance notice. In certain situations, it is possible to take a leave of absence without financial support.

14. Prior to graduation a student is required to clean out his/her laboratory space including a removal of waste solvents and hazardous material.

15. Failure to comply with all of the above course requirements may result in termination or delay graduation.

Facilities

The Kent Hale Smith Science and Engineering Building houses the Department of Macromolecular Science. The building was built in 1993, and specifically designed to meet the specific needs of polymer research. The facility consists of five floors, plus a basement. The laboratories for chemical synthesis are located principally on the top floor, the molecular and materials characterization laboratories on the middle floors, and the major engineering equipment on the ground floor, while the NMR, MALDI-TOF, and TA-InstrumentsThermal Characterization instrumentation are located in the basement. Modern, computer-interfaced classrooms are installed on the ground floor. Additional instrumentation available includes Small and Wide-Angle X-ray diffractometers; scanning electron microscopy; a complete range of molecular spectroscopic equipment including FTIR, Laser Raman, and high resolution solution and solid-state NMR (including imaging), as well as Raman and FTIR microscopes; and dynamic light scattering spectroscopy. There are also facilities for polymer characterization (molecular weight distribution), optical microscopy, solution and bulk rheology, scanning calorimetry, and for testing and evaluating the mechanical properties of materials. A newly built-out processing lab provides the complete suite of Thermo-Fisher batch, single- and twin-screw mixing and extrusion equipment, as well as that manufacturer’s state of the art rheometers. The C. Richard Newpher polymer processing laboratory includes a high temperature Rheometrics RMS-800 dynamic mechanical spectrometer, a Bomem DA-3 FTIR with FT-Raman capabilities, a compression molding machine, a Brabender plasticorder, a high speed Instron testing machine, and a vibrating sample magnetometer. The Charles E. Reed ’34 Laboratory is concerned with the mechanical analysis of polymeric materials. The major testing is done by Instron Universal testing instruments including an Instron model 1123 with numerous accessories such as an environmental chamber for high or low temperature experiments. Additional mechanical testing of fibers, films and injection-molded (Boy model 22-S) are provided by MTS universal testers which are used for both research and undergraduate teaching laboratory classes. The NSF Center for Layered Polymeric Systems (CLiPS) has its central facility within the department, with three cutting-edge multilayer extrusion systems as its centerpiece. CLiPS also operates a Bruckner KARO IV biaxial stretching unit, which allows controlled biaxial stretching of polymer films, and an Atomic Force Microscope which probes the morphological and mechanical properties of materials at the nanoscale. The Molecular Modeling Center provides access to various software packages for the rheological and molecular modeling of polymers.

Faculty

David Schiraldi, PhD
(University of Oregon)
Peter A. Asseff Professor and Chair
Advanced composites based on aerogels and nanofillers, monomer and polymer synthesis, structure-property relationships, polymer degradation, polymerization catalysis, synthetic fibers, barrier packaging materials.

Rigoberto C. Advincula, PhD
(University of Florida)
Professor
Design and synthesis of nanostructured materials, dendrimers, polymer brushes, thin films, and the use of innovative surface characterization techniques. Applications in electro-optical devices, sensors, biomaterials, and smart coatings.
Eric Baer, DEng
(Johns Hopkins University)
*Director, Centered for Layered Polymeric Systems (CLiPS) and Herbert Henry Dow Professor of Science and Engineering*
Multilayered and ultrathin polymer films and devices. Irreversible microdeformation mechanisms; pressure effects on morphology and mechanical properties; relationships between hierarchical structure and mechanical function; mechanical properties of soft connective tissue; polymer composites and blends; polymerization and crystallization on crystalline surfaces; viscoelastic properties of polymer melts; damage and fracture analysis of polymers and their composites. Structure-property relationships in biological systems

Liming Dai, PhD
(Australian National University)
*Kent Hale Smith Professor*
Multifunctional nanomaterials; optoelectronic macromolecules; and biomaterials and bioinspiration

Michael Hore, PhD
(University of Pennsylvania)
*Assistant Professor*
Polymer physics; neutron scattering; polymer nanocomposites; grafted polymers and brushes; theory and modeling; self-consistent field theory; structure-property relationships; reconfigurable materials.

Hatsuo Ishida, PhD
(Case Western Reserve University)
*Professor*
Processing of polymers and composite materials; structural analysis of surfaces and interfaces; molecular spectroscopy of synthetic polymers

LaShanda T. Korley, PhD
(Massachusetts Institute of Technology)
*Associate Professor*
Structure-function relationships; toughening mechanisms in segmented copolymers; spatial confinement of self-assembled materials, including biomaterials; hierarchical microstructures

João Maia, PhD
(University of Wales Aberystwyth, U.K.)
*Associate Professor*
Polymer rheology: extensional rheology and rheometry; micro- and nano-rheology; bio-rheology: food rheology and processing; rheology for macromolecular technology: development and optimization of polymer blends and composites; viscoelasticity of micro- and nano-layered polymer films; on- and in-line monitoring of extrusion-based processes; micro-processing; environmental rheology and processing

Ica Manas-Zloczower, DSc
(Israel Institute of Technology)
*Professor*
Structure and micromechanics of fine particle clusters; interfacial engineering strategies for advanced materials processing; dispersive mixing mechanisms and modeling; design and mixing optimization studies for polymer processing equipment through flow simulations

John Pokorski, PhD
(Northwestern University)
*Assistant Professor*
Biomaterials for delivery of therapeutic proteins; protein-polymer conjugates; drug-delivery; biopolymer catalysts; self-assembling peptides; affinity-based delivery of therapeutics; layered polymeric delivery systems

Gary Wnek, PhD
(University of Massachusetts, Amherst)
*Associate Chair and The Joseph F. Toot, Jr.*, Associate Chair and The Joseph F. Toot, Jr.
Polymers with unusual electrical or optical properties; biomaterials for tissue engineering and regenerative medicine; electric field-mediated processing (electrospinning of nano- and micro fibers and morphology modulation in polymer blends); polymer-based microfluidic platforms; polymer product design

Lei Zhu, PhD
(University of Akron)
*Professor*
Nanoscale structure and morphology of crystalline/liquid crystalline polymers and block copolymers; ferroelectric and dielectric polymers for electric energy storage; polymer/inorganic hybrid nanocomposites; biodegradable polymers for diagnostic and drug delivery

**Emeriti Faculty**

John Blackwell, PhD
(University of Leeds, England)
*Leonard Case Jr. Professor*
Determination of the solid state structure and morphology of polymers. X-ray analysis of the structure of thermotropic copolysters, copolyimides, polyurethanes, polysaccharides; supramolecular assemblies, fluoropolymers; molecular modeling of semi-crystalline and liquid crystalline polymers; rheological properties of polysaccharides and glycoproteins

Alexander M. Jamieson, DPhil
(Oxford University, England)
*Professor*
Quasielastic laser light scattering; relaxation and transport of macromolecules in solution and bulk; structure-function relationships of biological macromolecules

Jack L. Koenig, PhD
(University of Nebraska, Lincoln)
*The Donnell Institute Professor Emeritus*
Polymer structure-property relationships using infrared, Raman, NMR spectroscopy and spectroscopic imaging techniques

Jerome B. Lando, PhD
(Polytechnic Institute of Brooklyn)
*Professor Emeritus*
Solid state polymerization; X-ray crystallography of polymers; electrical properties of polymers; ultra-thin polymer films
Morton H. Litt, PhD  
(Polytechnic Institute of Brooklyn)  
Professor Emeritus  
Kinetics and mechanisms of free radical and ionic polymerization; mechanical properties of polymers; fluorocarbon chemistry; synthesis of novel monomers and polymers; polymer electrical properties; cross-linked liquid crystal polymers

Secondary Faculty  
Emily Pentzer, PhD  
(Northwestern University)  
Assistant Professor  
Polymer Synthesis, Advanced Materials  

James M. Anderson, PhD  
(Oregon State University, M.D.)  
Professor of Macromolecular Science, Pathology, and Biomedical Engineering  
Biocompatibility, inflammation, foreign body reaction to medical devices, prostheses, and biomaterials  

Donald Feke, PhD  
(Princeton University)  
Professor of Chemical Engineering and Macromolecular Science  
Fine-particle processing, colloidal phenomena, dispersive mixing, and acoustic separation methods  

Roger French, PhD  
(Massachusetts Institute of Technology)  
F. Alex Nason Professor of Materials Science  
Optical materials and elements, optical properties and electronic structure of materials, and electrodynamic van der Waals-London dispersion interactions  

John Protasiewicz, PhD  
(Cornell University)  
Professor of Chemistry  
Inorganic, organic, main group, materials, polymer, catalysis, organometallic chemistry, and X-ray crystallography  

Charles Rosenblatt, PhD  
(Harvard University)  
Professor of Physics  
Experimental condensed matter physics and liquid crystal physics  

Kenneth Singer, PhD  
(University of Pennsylvania)  
Professor of Physics  
Modern optics and condensed matter experiment and nonlinear optics  

Philip Taylor, PhD  
(Cambridge University, England)  
Perkins Professor of Physics  
Phase transitions and equations of state for crystalline polymers; piezoelectricity and pyroelectricity  

Horst von Recum, PhD  
(University of Utah, Salt Lake City)  
Assistant Professor of Biomedical Engineering  
Novel platforms for the delivery of molecules and cells and the use of novel stimuli-responsive polymers for use in gene and drug delivery

Adjunct Faculty  
Thomas Chapin, PhD  
Vice President, UL Laboratories  
Polymer Flammability  

Alan Riga, PhD  
(Case Western Reserve University)  
Adjunct Full Professor  
Extensive industrial and forensic science experience in laboratory testing and characterization of materials, pharmaceuticals, excipients, proteins, metals, alloys, polymers, biopolymers, elastomers, organic chemicals, monomers, resins, thermosets, and thermoplastics  

Stuart Rowan, PhD  
(University of Glasgow)  
Professor  
Supramolecular Chemistry  

Christoph Weder, DrScNat  
(ETH Zurich Switzerland)  
Adjunct Full Professor  
Design, synthesis and investigation of structure-property relationships of novel functional polymers: polymers with unusual optic and/or electronic properties; (semi)conducting conjugated polymers; stimuli-responsive polymers; biomimetic materials, polymer nanocomposites, supramolecular chemistry.

Courses  
EMAC 125. Freshman Research on Polymers. 1 Unit.  
Freshman research in polymer chemistry, engineering, and physics. Students will be placed in active research groups and will participate in real research projects under the supervision of graduate students and faculty mentors.  

EMAC 270. Introduction to Polymer Science and Engineering. 3 Units.  

EMAC 276. Polymer Properties and Design. 3 Units.  
The course reviews chemical and physical structures of a wide range of applications for synthetic and natural polymers, and addresses "Which polymer do we choose for a specific application and why?" We examine the polymer properties, the way that these depend on the chemical and physical structures, and reviews how they are processed. We aim to understand the advantages and disadvantages of the different chemical options and why the actual polymers that are used commercially are the best available in terms of properties, processibility and cost. The requirements include two written assignments and one oral presentation. Prereq: ENGR 145 and EMAC 270.  

EMAC 303. Structure of Biological Materials. 3 Units.  
Structure of proteins, nucleic acids, connective tissue and bone, from molecular to microscopic levels. An introduction to bioengineering biological materials and biomimetic materials, and an understanding of how different instruments may be used for imaging, identification and characterization of biological materials. Offered as: EBME 303 and EMAC 303. Recommended preparation: EBME 201, EBME 202, and EMAC 270.
EMAC 325. Undergraduate Research in Polymer Science. 1 - 3 Units.
Undergraduate laboratory research in polymer chemistry/physics/engineering. Students will undertake an independent research project, working under the mentoring of both a graduate student and a faculty member. A mid-term progress report is required. A written report and oral presentation will be made at the end of the semester. Can be taken for 1-3 credits per semester, up to a total of 6 credit hours. Students are expected to spend approximately 5 hours/week in the laboratory per credit registered each semester. Recommended preparation: Sophomore/Junior standing and consent of instructor.

EMAC 351. Physical Chemistry for Engineering. 3 Units.
Principles of physical chemistry and their application to systems involving physical and chemical transformations. The nature of physical chemistry, properties of gases, overview of the laws of thermodynamics, thermochemistry, solutions, phases and chemical equilibrium, kinetics of chemical reaction, solutions of electrolytes and introduction to quantum mechanics, atomic structure and molecular statistics. Prereq: ENGR 145.

EMAC 352. Polymer Physics and Engineering. 3 Units.
Single chain statistics and thermodynamics of dilute polymer solutions (single chain statistics, Flory-Krigbaum theory, vapor pressure and osmotic pressure, light, small angle X-Ray, and small-angle neutron scattering), solid state properties of polymers (polymer viscoelasticity (time-temperature superposition; rubber thermodynamics and statistics), glasses and related mechanical properties (fracture mechanism), crystals and liquid crystals; structure property relationship, polymer blends, block copolymers and composites, transport phenomena (conversation of mass, momentum and energy, differential forms, integral forms, momentum transport, laminar and turbulent flow, Navier-Stokes equation, mass transport, diffusion, Fick’s law) and transport phenomena of polymer solutions (intrinsic viscosity, sedimentation and diffusion, dynamic light scattering, polyelectrolytes and block copolymer in solution, size exclusion chromatography). Prereq: EMAC 351

EMAC 355. Polymer Analysis Laboratory. 3 Units.
Experimental techniques in polymer synthesis and characterization. Synthesis by a variety of polymerization mechanisms. Quantitative investigation of polymer structure by spectroscopy, diffraction and microscopy. Molecular weight determination. Physical properties. Prereq: EMAC 276 and (CHEM 290 or CHEM 322).

EMAC 370. Polymer Chemistry. 3 Units.
The fundamentals of organic chemistry of polymer synthesis, suitable for laboratory and industrial polymer production. Prereq: EMAC 270 and (CHEM 224 or CHEM 324).

EMAC 372. Polymer Processing and Testing Laboratory. 3 Units.
Basic techniques for the rheological characterization of thermoplastic and thermoset resins; "hands-on" experience with the equipment used in polymer processing methods such as extrusion, injection molding, compression molding; techniques for mechanical characterization and basic principles of statistical quality control. Prereq: EMAC 377.

EMAC 375. Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology. 3 Units.
This course will involve the study of Rheology from the perspectives of rheological property measurement, phenomenological and molecular models, and applicability to polymer processing. In particular, students will be introduced to: 1) General concepts of Rheology and Newtonian Fluid Mechanics, 2) Standard flows and material functions; 3) The role of Rheology as a structural characterization tool, with an emphasis on polymeric systems; 4) Experimental methods in Rheology with quantitative descriptions of associated flows and data analyses; 5) Viscoelasticity and Non-Newtonian Fluid Mechanics, including the application of models, both phenomenological and molecular, to the prediction of rheological behavior and extraction of model parameters from real data sets; and 6) The relevance of rheological behavior of different systems to practical processing schemes, particularly with respect to plastics manufacturing. Offered as EMAC 375 and EMAC 475. Prereq: ENGR 225 or EMAC 404.

EMAC 376. Polymer Engineering. 3 Units.
Mechanical properties of polymer materials as related to polymer structure and composition. Viscoelastic behavior, yielding and fracture behavior including irreversible deformation processes. Recommended preparation: ENGR 200. Offered as EMAC 376 and EMAC 476. Prereq: EMAC 276.

EMAC 377. Polymer Processing. 3 Units.
Application of the principles of fluid mechanics, heat transfer and mass transfer to problems in polymer processing; elementary steps in polymer processing (handling of particulate solids, melting, pressurization and pumping, mixing); principles and procedures for extrusion, injection molding, reaction injection molding, secondary shaping. Prereq: EMAC 352 or ENGR 225.

EMAC 378. Polymer Engineer Design Product. 3 Units.
Uses material taught in previous and concurrent courses in an integrated fashion to solve polymer product design problems. Practicality, external requirements, economics, thermal/mechanical properties, processing and fabrication issues, decision making with uncertainty, and proposal and report preparation are all stressed. Several small exercises and one comprehensive process design project will be carried out by class members. Offered as EMAC 378 and EMAC 478. Counts as SAGES Senior Capstone.

EMAC 379. Advanced Polymer Engineering. 2 Units.
This Advanced Polymer Engineering course will focus on the ultimate engineering properties for polymers, including fracture mechanics, electrical, and optical properties of polymers. For polymer fracture mechanics, deformation and fracture behavior of polymers will be introduced. The electrical properties include both insulation and conduction/semiconductor properties for polymers. In the optical property section, we will introduce polymer photonics and polymers in liquid crystal displays. The goal of the course is to help students achieve fundamental understanding of advanced polymer properties. EMAC 479 students will do an additional project design. Offered as EMAC 379 and EMAC 479. Prereq: EMAC 376.

EMAC 396. Special Topics. 1 - 18 Units.
(Credit as arranged.)

EMAC 398. Polymer Science and Engineering Project I. 1 - 3 Units.
(Senior project). Research under the guidance of faculty. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Repeatable up to 3 credit hours. When taken for 3 credits it may be spread over two successive semesters. Counts as SAGES Senior Capstone. Prereq: Senior Standing.
EMAC 399. Polymer Science and Engineering Project II. 1 - 9 Units.
(Senior project.) Research under the guidance of staff, culminating in thesis. Recommended preparation: Majors only and senior standing.

EMAC 400T. Graduate Teaching I. 0 Unit.
This course will engage the Ph.D. students in teaching experiences that will include non-contact (such as preparation and grading of homeworks and tests) and direct contact (leading recitations and monitoring laboratory works, lectures and office hours) activities. The teaching experience will be conducted under the supervision of the faculty. All Ph.D. students will be expected to perform direct contact teaching during the course sequence. The proposed teaching experiences for EMAC Ph.D. students are outlined below in association with undergraduate classes. The individual assignments will depend on the specialization of the students. The activities include grading, recitation, lab supervision and guest lecturing. Recommended preparation: Ph.D. student in Macromolecular Science.

EMAC 401. Polymer Foundation Course I: Organic Chemistry. 3 Units.
The class is an introduction to the synthesis and organic chemistry of macromolecules. The course introduces the most important polymerization reactions, focusing on their reaction mechanisms and kinetic aspects. Topics include free radical and ionic chain polymerization, condensation (step-growth) polymerization, ring-opening, insertion and controlled addition polymerization. There is no limit on the number of students for the class as a whole.

EMAC 402. Polymer Foundation Course II: Physical Chemistry. 3 Units.
This class is an introduction to the physical chemistry of polymers in solution. Topics include: polymer statistics: (microstructure, chain configuration, and chain dimensions), thermodynamics and transport properties of polymers in solution, methods for molecular weight determination, physical chemistry of water-soluble polymers, and characterization of polymer microstructure (IR and NMR). There is no limit on the number of students for the class as a whole.

EMAC 403. Polymer Foundation Course III: Physics. 3 Units.
This class is an introduction to the physics of polymers in the bulk amorphous and crystalline states. Topics include: structural and morphological analysis using X-ray diffraction, electron microscopy and atomic force microscopy, characterization of thermal transitions, viscoelastic behavior and rubber elasticity, and dynamic mechanical analysis. There is no limit on the number of students for the class as a whole.

EMAC 404. Polymer Foundation Course IV: Engineering. 3 Units.
This class is an introduction to the engineering and technology of polymeric materials. Topics include: additives, blends and composites, natural polymers and fibers, thermoplastics, elastomers, and thermosets, polymer degradation and stability, polymers in the environment, polymer rheology and polymer processing, and polymers for advanced technologies (membrane science, biomedical engineering, applications in electronics, photonic polymers). There is no limit on the number of students for the class as a whole.

EMAC 405. Polymer Characterization Laboratory. 3 Units.
Laboratory experience through synthesis and characterization of polymers. Synthesis via addition and condensation polymerization. Characterization methods include size exclusion chromatography, infrared and NMR spectroscopy. Solid samples are characterized by x-ray diffraction, electron microscopy, thermal analysis, and physical properties. Fluid samples are characterized by melt rheology. Prereq: EMAC 401, EMAC 402, EMAC 403 and EMAC 404.

EMAC 410. Polymers Plus Self - Assembly and Nanomaterials. 2 Units.
The course focuses on the concepts of supramolecular chemistry and self-assembly specifically as it applies to nano-polymeric systems. After dealing with many of the fundamental aspects of supramolecular chemistry the focus of the class deals with how to access/ utilize nano-scale features using such processes, namely the 'bottom-up' approach to nanomaterials/systems. Areas which will be addressed include block copolymers, DNA assemblies, nanotubes and dendrimers. Prereq: EMAC 401 or EMAC 370.

EMAC 413. Polymers Plus Green Chemistry and Engineering. 2 Units.
This course focuses on green chemistry and engineering, particularly as it relates to polymers. Specific topics to be covered in this course will include green chemistry, catalysis, alternative solvents, green processing, renewable materials, and life cycle analysis. Case studies will be utilized to connect lecture topics to real-world examples. Prereq: EMAC 401 and EMAC 404.

EMAC 414. Polymers Plus Advanced Composite and Nanocomposite Materials and Interfaces. 2 Units.
"Advanced Composite and Nanocomposite Materials and Interfaces" will aim at providing advanced concept in composite material structures, importance of interface on the property development, rheological background to be able to manufacture optimized materials, and appropriate processing technologies to choose for a specific product to be manufactured. Specifically, this course will discuss the following items: 1. Basic concept of heterogeneous materials including advantages and problems associated with making multiphase materials. 2. It will review broadly the materials used to make composites and nanocomposites. 3. Unique properties of composites/nanocomposites in rheological, mechanical, and physical properties will be discussed. 4. Various composite processing techniques will be discussed in detail. 5. Surface treatment of the reinforcing materials and interface/interphase structures of composites/nanocomposites will be discussed.

EMAC 415. Polymers Plus Structure and Morphology. 2 Units.
This special topic focuses on polymer structure and morphology and their applications. Topics include solid-state physics of various polymeric materials, ranging from crystalline polymers to liquid crystalline polymers, and block copolymers. First, symmetry operation, space groups, reciprocal spaces are introduced. Examples of the crystalline structures of industrially important polymers and typical polymer crystalline morphology such as lamellar and spherulitic crystals are discussed. Defects in crystalline polymer is also an important issue that determines their physical properties. Second, typical phase structure and transitions of liquid crystals and liquid crystalline polymers are introduced, including both thermotropic and lyotropic liquid crystals. Finally, nanostructure and morphology of block copolymers are discussed. Prereq: EMAC 402 and EMAC 403.
EMAC 417. Functional Polymers. 2 Units.  
Polymers have traditionally been used for the so-called passive applications in many areas, ranging from engineering materials to electronics devices. Various functional polymers have now been synthesized with unusual electronic, optical, and mechanical properties. These properties allow polymers to be used as active components for various applications, where they play an active role in regulating the property of materials and performance of devices. Examples include, but not limited to, polymer sensors, polymer actuators, polymer light-emitting diodes, and polymer photovoltaic cells. The objective of this proposed course is to provide polymer engineering and polymer science students with the recent development in functional polymers and their device-related applications. Course Outline: 1). The Concept of Functional Polymers (0.5 week) 2). Electronically Active polymers (1 weeks) · Synthesis, Structure, Conduction Mechanism, and Property 3). Optically Active Polymers (1.5 weeks): Light-Emitting Polymers, Photovoltaic Polymers, Non-Linear Optical Polymers 4). Stimuli-Responsive Polymers (2 weeks): Solvent/ Temperature/pH Responsive Polymers, Field Responsive Polymers 5). Functional Polymers for Device Applications (2 weeks): Polymer Sensors and Actuators, Plastic Electronics, Polymer Light-Emitting Diodes and Photovoltaic Cells, Polymeric Biomedical Devices

EMAC 421. Polymer Plus Hierarchical Structures and Properties. 2 Units.  
Discuss the hierarchical solid state structure of synthetic and naturally occurring polymeric systems and relate these structures to their properties. Particular emphasis will be on natural systems containing collagen(s) and carbohydrate(s), and on synthetic crystalline, liquid crystalline, and reinforced composite polymeric materials. In order to prepare students for application of these concepts we will determine how mechanical, transport and optical (photonic) behavior can be controlled by structure manipulation. Prereq: EMAC 403 and EMAC 404.

EMAC 422. Polymers Plus Microscopy. 2 Units.  
This course focuses on application of microscopy techniques to the analysis of the microstructure of polymeric materials. Specifically, atomic force microscopy, transmission and scanning electron microscopy, and optical microscopy will be discussed. Practical aspects of these techniques will be applied to a variety of systems, including block copolymers, nanocomposites, LC polymers, and multi-layered films. Prereq: EMAC 403.

EMAC 423. Polymers Plus Adhesives, Sealants and Coatings. 2 Units.  

EMAC 425. Polymer Plus Energy. 2 Units.  
Energy research has become the focus of the twenty-first century. This course is a special topic on polymers in the energy field and related applications. We primarily focus on polymers for solar cells, fuel cells, batteries, double layer electrochemical capacitors, dielectric capacitors, and wind energy. For solar cells, we will introduce conducting polymers and basic types of polymer solar cells. For fuel cells, we will introduce both proton- and hydroxide-exchange fuel cells. Fundamental issues of ion transport, water management, and fuel cell longevity will be introduced. For supercapacitors, we will introduce porous carbon structures and charge storage mechanism. For dielectric capacitors, we will introduce fundamental concepts in electrostatics, different types of polarization, and loss mechanism. For wind energy, we will introduce polymer composites for wind blades and polymer coatings. This course will combine lectures and contemporary literature reviews/essays.

EMAC 426. Biopolymers: Structure, Synthesis, and Application in Medicine. 2 Units.  
An introduction to biomacromolecules including DNA, RNA, and proteins. The course will deal with the synthesis and manipulation of biological and synthetic macromolecules as it applies to topics in modern medicine. Topics covered will include nanoparticle gene and drug delivery systems, polymer hydrogels, polymer imaging agents, and protein-polymer conjugates. The purpose of this course is to provide a survey of important areas in medicine where a polymer chemist/engineer can intervene to make a meaningful contribution. Prereq: CHEM 323 and CHEM 324.

EMAC 427. Polymers Plus a Sustainable Economy. 2 Units.  
This course is an interdisciplinary seminar-based course surveying the diverse roles played by polymers in a sustainable economy. Specific topics for discussion include: (i) Renewable Energy and the Sustainable Economy; (ii) Renewable Polymers and the Sustainable Economy; (iii) Challenges for Biotechnology in the Sustainable Economy; (iv) Lifetime Analysis of Polymers; Green Policy in the Sustainable Economy; (v) Sustainable Product Innovation in Northeast Ohio; (vi) Advanced Manufacturing for a Sustainable Economy in Northeast Ohio; (vii) Eco-conscious business models in the polymer industry (viii) Bioethics in Biotechnology; (ix) Alternative Solvents and Processing; and (x) Polymers for Energy Storage and Delivery. Prereq: EMAC 401 and EMAC 404.

EMAC 450. The Business of Polymers. 2 Units.  
This course will link polymer technology to business and management issues that need to be considered for successful technology commercialization. Topics include project management, finance, opportunity assessment, the voice of the customer, and protection of intellectual property. Case studies from both large and small companies will be used to illustrate key concepts. Recommended preparation: EMAC 270, EMAC 276.
EMAC 460. Polymers Plus Structure-Property Relationships: A Polymer Per Week. 2 Units.
This course serves as a graduate-level introduction to structure-property relationships for synthetic as biologically-derived macromolecules. One specific macromolecular system will be selected per week, with detailed analysis that includes historical considerations, synthesis, chemical and physical structure, and processing, and how these relate intimately to properties (e.g., mechanical, optical, thermal, electrical) and performance. Examples of selected polymers include polyethylene, vinyl polymers, biodegradable synthetic polyesters, high-performance fibers, biopolymers such as collagen and silk, and intrinsically conducting polymers. Discussions will also include emerging opportunities for polymers chosen and potential limitations to a broader range of applications. Grades will be determined from two detailed papers focusing on the molecular origins of structure-property relationships, a presentation on one of the papers, and in-class participation. Prereq: EMAC 270 or requisites not met permission.

EMAC 461. Chemistry of Fire Safe Polymers and Composites. 3 Units.
Chemistry of Fire Safe Polymers and Composites starts with the introduction of characterization techniques used for fire safe materials and combustion phenomena research. General discussion on how reduced flammability of polymers and composites is obtained, for example by additives and preparing intrinsically thermally stable chemical structure and some examples of smart approaches, will be discussed. It also discusses the synthetic methods of preparing high temperature stable polymers in addition to the raw materials used to prepare those materials. Special emphasis will be placed on the thermal stability data obtained by thermogravimetric analysis (TGA) and combustion calorimetry for those fire safe materials. Mechanistic aspects of the flammability of polymers will be explained with special emphasis on the molar contribution of chemical functionality to the heat release capacity. Theoretical derivation of thermokinetic parameters will be explained. In addition, a common sense build-up will be attempted by providing actual numbers associated with those thermokinetic parameters. Upon completion of background formation, a more advanced materials, composites and nanocomposites, will be discussed using the results recently reported. Preliminary attempts to explain flame retardation by nanocomposite structures will also be discussed. Offered as EMAC 461 and EMAE 461.

EMAC 463. Fire Dynamics. 3 Units.
This course introduces compartment fires and burning behavior of materials. Topics include: buoyant driven flow, fire plume, ceiling jet, vent flow, flashover and smoke movement as well as steady burning of liquids and solids; ignition, extinction and flame spread over solids. Recommended Preparation: Elementary knowledge in thermo-fluids is required. Offered as EMAE 463 and EMAC 463.

EMAC 464. Fire Protection Engineering. 3 Units.
This course introduces essentials of fire protection in industry and houses. Topics include: hazard identification (release of flammable gases and their dispersion), fire and explosion hazards, prevention and risk mitigation, fire detection systems, mechanisms of fire extinguishment, evaluation of fire extinguishing agents and systems. Offered as EMAC 464 and EMAE 464.

EMAC 467. Polymers in Medicine. 3 Units.
This course covers the important fundamentals and applications of polymers in medicine, and consists of three major components: (i) the blood and soft-tissue reactions to polymer implants; (ii) the structure, characterization and modification of biomedical polymers; and (iii) the application of polymers in a broad range of cardiovascular and extravascular devices. The chemical and physical characteristics of biomedical polymers and the properties required to meet the needs of the intended biological function will be presented. Clinical evaluation, including recent advances and current problems associated with different polymer implants. Recommended preparation: EBME 306 or equivalent. Offered as EBME 406 and EMAC 471.

EMAC 475. Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology. 3 Units.
This course will involve the study of Rheology from the perspectives of rheological property measurement, phenomenological and molecular models, and applicability to polymer processing. In particular, students will be introduced to: 1) General concepts of Rheology and Newtonian Fluid Mechanics, 2) Standard flows and material functions; 3) The role of Rheology as a structural characterization tool, with an emphasis on polymeric systems; 4) Experimental methods in Rheology with quantitative descriptions of associated flows and data analyses; 5) Viscoelasticity and Non-Newtonian Fluid Mechanics, including the application of models, both phenomenological and molecular, to the prediction of rheological behavior and extraction of model parameters from real data sets; and 6) The relevance of rheological behavior of different systems to practical processing schemes, particularly with respect to plastics manufacturing. Offered as EMAC 375 and EMAC 475. Prereq: ENGR 225 or EMAC 404.

EMAC 476. Polymer Engineering. 3 Units.
Mechanical properties of polymer materials as related to polymer structure and composition. Visco-elastic behavior, yielding and fracture behavior including irreversible deformation processes. Recommended preparation: ENGR 200. Offered as EMAC 376 and EMAC 476.

EMAC 477. Elementary Steps in Polymer Processing. 3 Units.
This course is an application of principles of fluid mechanics and heat transfer to problems in polymer processing. In the first part of the course, basic principles of transport phenomena will be reviewed. In the second part, the elementary steps in polymer processing will be described and analyzed with application to a single screw extruder.

EMAC 478. Polymer Engineer Design Product. 3 Units.
Uses material taught in previous and concurrent courses in an integrated fashion to solve polymer product design problems. Practicality, external requirements, economics, thermal/mechanical properties, processing and fabrication issues, decision making with uncertainty, and proposal and report preparation are all stressed. Several small exercises and one comprehensive process design project will be carried out by class members. Offered as EMAC 378 and EMAC 478. Counts as SAGES Senior Capstone.
**EMAC 479. Advanced Polymer Engineering. 2 Units.**
This Advanced Polymer Engineering course will focus on the ultimate engineering properties for polymers, including fracture mechanics, electrical, and optical properties of polymers. For polymer fracture mechanics, deformation and fracture behavior of polymers will be introduced. The electrical properties include both insulation and conduction/semiconductor properties for polymers. In the optical property section, we will introduce polymer photonics and polymers in liquid crystal displays. The goal of the course is to help students achieve fundamental understanding of advanced polymer properties. EMAC 479 students will do an additional project design. Offered as EMAC 379 and EMAC 479. Prereq: EMAC 404.

**EMAC 480. Writing an NSF-Style Scientific Proposal. 2 Units.**
The aim of this course is to learn how to develop a National Science Foundation (NSF) grant proposal. The class will include all aspects of building an NSF proposal from the intellectual Merit of the scientific content to its Broader impacts. It will also focus on how to put together the other aspects required for an NSF proposal, such as budget, facilities, NSF-style bio, etc. The class will involve some lectures on the basics of putting the proposal together (best practices, etc.) followed by writing the NSF proposal using the NSF’s current Grant Proposal Guide (GPG). The class will meet once a week to discuss the progress of each of the student’s proposals. The students will be expected to come up with their own polymer-related scientific idea for the grant proposal (which has to be approved by the Macromolecular Sci & Eng Graduate Committee before the end of the second week of class). Toward the end of the class, all proposals will be evaluated by the students (each student will be assigned as a primary reviewer for some of the proposals, a secondary reviewer and a scribe for others). The class will then hold a NSF-style proposal panel review. Each proposal will be awarded an NSF evaluation grade (Excellent, Very Good, Good, Fair, Poor) and a final review report for each proposal will be drafted by the students. The final grade for this class depends on the quality of the proposal as well as the students’ participation in the NSF-style panel review process.

**EMAC 490. Polymers Plus Professional Development. 1 Unit.**
This course focuses on graduate student professional development. The course involves weekly meetings and oral presentations with attention on the content and style of the presentation materials (PowerPoint, posters, etc.), oral presentation style and project management skills. This course can be taken for the total of 3 credits over three different semesters.

**EMAC 491. Polymers Plus Literature Review. 1 Unit.**
This course involves weekly presentations of the current polymer literature. It involves at least one presentation by the enrolled student and participation in all literature reviews (at least 10/semester). The course will focus on presentation skills (both oral and written), scientific interpretation, and development of peer-review skills. This course can be taken for a total of 3 credits over three different semesters.

**EMAC 492. Carbon Nanoscience and Nanotechnology. 3 Units.**
This course presents the fundamental aspects of nanoscience and nanotechnology with an emphasis on carbon nanomaterials and nanodevices. This proposed course intends to provide students with the fundamental aspects of nanoscience and nanotechnology. Nanotechnology draws on the strengths of all the basic sciences and is the engineering at the molecular level, which has the potential to lead to novel scientific discoveries as well as new industrial technologies. This course will give students insight into a new, exciting and rapidly developing field. The course has a good balance between basic knowledge and depth with a focus on some key application areas, which will enable students to work in a variety of scientific professions.

**EMAC 500T. Graduate Teaching II. 0 Unit.**
This course will engage the Ph.D. students in teaching experiences that will include non-contact and direct contact activities. The teaching experience will be conducted under the supervision of the faculty. All Ph.D. students are outlined below in association with graduate classes. The individual assignments will depend on the specialization of the students. The activities include grading, recitation, lab supervision and guest lecturing. Recommended preparation: Ph.D. student in Macromolecular Science.

**EMAC 560. Macromolecules and Cells: A Materials Framework. 2 Units.**
This course aims to provide a broad overview of the structure and function of cellular macromolecules, with the major focus being an exploration biological cells as soft materials. Special emphasis is given to connections between cell material properties and macromolecular assemblies (e.g., viscoelasticity and cytoskeletal networks) and roles in determining mechanical, physical, electrical and transport properties. Material properties of collections of cells, namely selected tissues and organs, will be also discussed with special attention to irritability and motion and the design of smart materials and artificial cells using fundamental concepts from macromolecular science and engineering.

**EMAC 600T. Graduate Teaching III. 0 Unit.**
This course will engage the Ph.D. students in teaching experiences that will include non-contact and direct contact activities. The teaching experience will be conducted under the supervision of the faculty. The proposed teaching experiences for EMAC Ph.D. student in this course involve instruction in the operation of major instrumentation and equipment used in the daily research activities. The individual assignments will depend on the specialization of the students. Recommended preparation: Ph.D. student in Macromolecular Science.

**EMAC 601. Independent Study. 1 - 18 Units.**
(Credit as arranged.)

**EMAC 651. Thesis M.S.. 1 - 18 Units.**
(Credit as arranged.)

**EMAC 673. Selected Topics in Polymer Engineering. 2 - 3 Units.**
Timely issues in polymer engineering are presented at the advanced graduate level. Content varies, but may include: mechanisms of irreversible deformation: failure, fatigue and fracture of polymers and their composites; processing structure-property relationships; and hierarchical design of polymeric systems. Recommended preparation: EMAC 376 or EMAC 476.

**EMAC 677. Colloquium in Macromolecular Science and Engineering. 0 - 1 Units.**
Lectures by invited speakers on subjects of current interest in polymer science and engineering. This course can be taken for 3 credits over three different semesters.

**EMAC 690. Special Topics in Macromolecular Science. 1 - 18 Units.**

**EMAC 701. Dissertation Ph.D.. 1 - 9 Units.**
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

**Department of Materials Science and Engineering**

312 White Building (7204)
Materials science and engineering is a discipline that extends from the microscopic structure and properties of materials to the design and evaluation of materials in engineering systems. Achievements in materials science underpin the revolutionary advances in technology that define the modern standard of living. The role of a materials engineer is to understand why materials behave as they do under various conditions, to recognize the limits of performance that particular materials can attain, and to know what can be done during the manufacture of materials to meet the demands of a given application.

The Department of Materials Science and Engineering of the Case School of Engineering offers programs leading to the degrees of Bachelor of Science in Engineering, Master of Science, and Doctor of Philosophy. The technological challenges that materials engineers face demand a breadth of knowledge across a broad spectrum of engineering materials. The Department conducts academic and research activities with metals, ceramics, polymers, composites, and electronic materials. Timely research and education respond to the demands for new materials and improved materials performance in existing applications, often transcending the traditional materials categories.

While a discipline of engineering, the field brings basic science to bear on the technological challenges related to materials products and their manufacture. Materials science draws on chemistry in its concern for bonding, synthesis, and composition of engineering materials and their chemical interactions with the environment. Physics provides a basis for understanding the mechanical, thermal, optical, magnetic, and electrical properties of materials and provides the tools needed to ascertain the structure and properties of materials. Quantitative physical theories and modeling of fundamental materials science phenomena, microstructural analysis, materials design, and manufacturing processes are examples of the growing importance of mathematics and computation in materials science and engineering.

Mission
The Department of Materials Science and Engineering engages faculty, students, postdoctoral researchers, engineers, and staff in developing and understanding relationships between processing, structure, properties, and the performance of materials in engineering applications. The Department provides a research-intensive environment that encourages collaboration and underpins modern education in the field. This environment provides a strong foundation for advancing the frontiers of materials research, developing important technical innovations, and preparing engineers and scientists for challenging leadership careers.

Research Areas
Deformation and Fracture
Relationships between structure and mechanical behavior of traditional and advanced materials: metals, ceramics, intermetallics, composites, and biological materials. State-of-the-art facilities are available for deformation processing as well as mechanical testing over a range of strain rates, test temperatures, stress states, and size scales for both monotonic and cyclic conditions.

Materials Processing
Alloy surface engineering, crystal growth, thin-film deposition, casting of metal alloys, metallic glasses by rapid solidification, powder synthesis, crystallization of amorphous alloys, consolidation processing, layered materials, plated metals and alloys, solution- and/or precipitation heat-treatments, thermo-mechanical processing, diffusion-bonding, brazing and welding of metals, glasses and ceramics, electro-chemical and thermo-chemical oxidation/reduction conversion processing of metal/oxide surface layers.

Environmental Effects

Surfaces and Interfaces
Material surfaces in vacuum, ambient and chemical environments, grain-and phase boundaries, hetero-interfaces between different metals, ceramics, carbon (graphite) and polymers.

Electronic, Magnetic, and Optical Materials
Materials for energy technologies, such as photovoltaics, organic and inorganic light emitting diodes and displays, fuel cells, electrolytic capacitors, building-envelope materials, and wind turbines. Processing, properties, and characterization of magnetic materials and ferroelectric and piezoelectric ceramics.

Microcharacterization of Materials
Facilities for high-resolution imaging, spatially resolved chemical analysis, and diffractometry. Conventional, analytical, and high-resolution transmission electron microscopy, scanning electron microscopy, focused ion beam techniques, scanning probe microscopy, light-optical microscopy, optical spectroscopies, surface analysis, and X-ray diffractometry.

Materials Data Science
Rapid qualification of alloys, data science applications in polymers and coatings. Distributed computing, informatics, statistical analytics, exploratory data analysis, statistical modeling, and prediction. Hadoop, cloud computing, and computationally intensive research is supported through the operation of a scalable high-performance computing (HPC) system.

Undergraduate Programs
The curriculum leading to the degree of Bachelor of Science in Engineering, Major in Materials Science and Engineering, consists of the "Engineering Core"—basic courses in mathematics, physics, chemistry, and engineering, with electives in social sciences and humanities—plus materials courses, which also allow students to choose one of several areas of concentration within the major. A total of 129 credit hours is required.

The Bachelor of Science degree program in Materials Science and Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).
Throughout the undergraduate curriculum in materials science and engineering, scientific fundamentals are integrated with coverage of current manufacturing, design, and applications of engineering materials.

The goal of the Department of Materials Science and Engineering is to prepare students for rewarding careers that provide creative, effective solutions to societal needs, through coursework and associated activities that emphasize:

- The interrelationships among the processing, structure, properties, and performance of engineering materials
- The mutual reinforcement of education and professional development throughout one’s career.

The undergraduate experience in Materials Science and Engineering at Case Western Reserve is marked by a high degree of hands-on experience and many opportunities for professional development before graduation. Lab courses, senior projects, and plant tours ensure that every student sees the field first-hand in current research and industrial settings.

Program Educational Objectives
1. Graduates will take an active part in professional organizations.
2. Graduates will assume leadership positions in materials science related industries.
3. Graduates will be effectively involved in solving technical problems.
4. Graduates may successfully enter and complete graduate and professional degree programs.

Student Outcomes
As preparation for achieving the above educational objectives, the BS degree program in Materials Science and Engineering is designed so that students attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Bachelor of Science in Engineering
Required Courses for Major in Materials Science and Engineering
In addition to Engineering Core (p. 1072) and CWRU General Education (p. 1053) requirements, the major requires the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMSE 110</td>
<td>Transitioning Ideas to Reality I - Materials in Service of Industry and Society</td>
<td>1</td>
</tr>
<tr>
<td>EMSE 120</td>
<td>Transitioning Ideas to Reality II - Manufacturing Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>EMSE 220</td>
<td>Materials Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>EMSE 228</td>
<td>Mathematical Methods for Materials Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 276</td>
<td>Materials Properties and Design</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 319</td>
<td>Processing and Manufacturing of Materials</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 320</td>
<td>Materials Laboratory II</td>
<td>1</td>
</tr>
<tr>
<td>EMSE 327</td>
<td>Thermodynamic Stability and Rate Processes</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 328</td>
<td>Meso-scale Science Including Nanotechnology</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 330</td>
<td>Materials Laboratory III</td>
<td>2</td>
</tr>
<tr>
<td>EMSE 343</td>
<td>Materials for Electronics and Photonics</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 345</td>
<td>Materials for Biological and Medical Technology</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 349</td>
<td>Materials for Energy and Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 372</td>
<td>Structural Materials by Design</td>
<td>4</td>
</tr>
<tr>
<td>EMSE 379</td>
<td>Design for Lifetime Performance</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 398</td>
<td>Senior Project in Materials I</td>
<td>1</td>
</tr>
<tr>
<td>EMSE 399</td>
<td>Senior Project in Materials II</td>
<td>2</td>
</tr>
<tr>
<td>Related Required Courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMAC 276</td>
<td>Polymer Properties and Design</td>
<td>3</td>
</tr>
<tr>
<td>EMAC 376</td>
<td>Polymer Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>48</td>
</tr>
</tbody>
</table>

Concentrations
The undergraduate program includes courses that expose students to greater depth in areas related to materials science and engineering. These concentration sequences are of two types:

- Students may select an area of concentration that is based on an application or subfield of engineering materials. Each concentration will be a coherent set of courses that, in conjunction with one or more of the courses already required for all EMSE majors plus a specified mathematics/natural science/statistics course, will provide significant depth in an area of materials specialization.
- Students also have the option of designing a concentration — Advanced Materials Science and Engineering — in consultation with their advisors and subject to approval by the department’s Undergraduate Studies Committee.

The proposed concentrations are below. All concentrations equal 12 credit hours (four courses).
Biomaterials
EBME 201 Physiology-Biophysics I * 3
EBME 202 Physiology-Biophysics II * 3
Plus two of the following:
EBME/EMAC 303 Structure of Biological Materials
EBME 305 Materials for Prosthetics and Orthotics
EBME 306 Introduction to Biomedical Materials
EBME 316 Biomaterials for Drug Delivery
EBME 325 Introduction to Tissue Engineering
EBME 406/EMAC 471 Polymers in Medicine
EBME/EECS 480B The Human Body

Electronic Materials
PHYS 221 Introduction to Modern Physics * 3
Plus three of the following (from either or both categories):
Emphasis on solid state physics:
PHYS 315 Introduction to Solid State Physics
PHYS 326 Physical Optics
PHYS 327 Laser Physics
PHYS 331 Introduction to Quantum Mechanics I
Emphasis on electronic device technology:
CHEM 340 Solar Energy Conversion
ECHE 383 Chemical Engineering Applied to Microfabrication and Devices
EECS 309 Electromagnetic Fields I
EECS 321 Semiconductor Electronic Devices
EECS 322 Integrated Circuits and Electronic Devices
EMSE 405 Dielectric and Electrical Properties of Materials
EMSE 427 Dislocations in Solids
EMSE 463 Magnetism and Magnetic Materials

Polymers
CHEM 223 Introductory Organic Chemistry I *
CHEM 323 Organic Chemistry I *
Plus three of the following:
EMAC 270 Introduction to Polymer Science and Engineering
EMAC 351 Physical Chemistry for Engineering
EMAC 355 Polymer Analysis Laboratory
EMAC 372 Polymer Processing and Testing Laboratory
EMAC 375 Fundamentals of Non-Newtonian Fluid Mechanics and Polymer Rheology
EMAC 377 Polymer Processing

Completion of this concentration (including EMAC 276 and EMAC 376, as required for the major in Materials Science and Engineering) satisfies the requirements for a minor in Polymer Science and Engineering.

Structural Materials and Mechanical Behavior
STAT 312 Basic Statistics for Engineering and Science * 3
Plus three of the following:
ECIV 211 Civil Engineering Materials
ECIV 310 Strength of Materials
EMAE 370 Design of Mechanical Elements
EMAE 378 Mechanics of Machinery I
EMSE 417 Properties of Materials in Extreme Environments
EMSE 421 Fracture of Materials
EMSE 422 Failure Analysis
EMSE 427 Dislocations in Solids
EMAE 480 Fatigue of Materials

* Satisfies the Mathematics/Science/Statistics requirement of the Case School of Engineering.

Advanced Materials Science and Engineering
Students may satisfy the concentration requirement by taking nine credits of courses from engineering, math, statistics, or natural sciences departments (beyond those specifically required in the curriculum) at the 300 level or above, plus a course to satisfy the Mathematics/Natural Sciences/Statistics requirement in the Engineering Core. The courses are to be selected in consultation with the student's advisor and will be subject to approval by the department's Undergraduate Studies Committee. This option is appropriate for students who desire further study in topics relevant to materials science and engineering that are not represented in the four specializations listed above.

Bachelor of Science in Engineering

Suggested Program of Study: Major in Materials Science and Engineering

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>SAGES First year Seminar*</td>
<td>4</td>
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<tr>
<td>PHED 1xx Physical Education Activities*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transitioning Ideas to Reality I - Materials in Service of Industry and Society (EMSE 110)b</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>Elementary Computer Programming (ENGR 131)**</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121)** or Physics and Frontiers I - Mechanics (PHYS 123)</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Transitioning Ideas to Reality II - Manufacturing Laboratory (EMSE 120)</td>
<td></td>
<td></td>
<td>2</td>
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<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
<td></td>
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</tbody>
</table>
SAGES University Seminar I* 3
Calculus for Science and Engineering II (MATH 122)** 4
PHED 1xx Physical Education Activities* 3

Year Total: 16 17

Second Year

<table>
<thead>
<tr>
<th>Course Description</th>
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</thead>
<tbody>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)** or Physics and Frontiers II - Electricity and Magnetism (PHYS 124)</td>
<td>4</td>
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<tr>
<td>Materials Properties and Design (EMSE 276)</td>
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<td></td>
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<tr>
<td>Concentration I*</td>
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<tr>
<td>SAGES University Seminar 2*</td>
<td>3</td>
<td></td>
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<tr>
<td>Calculus for Science and Engineering III (MATH 223)** or Calculus III (MATH 227)</td>
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<tr>
<td>Humanities/Social Science I**</td>
<td>3</td>
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<tr>
<td>Elementary Differential Equations (MATH 224)** or Differential Equations (MATH 228)</td>
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<tr>
<td>Statics and Strength of Materials (ENGR 200)**</td>
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<td>Materials Laboratory I (EMSE 220)</td>
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<tr>
<td>Mathematical Methods for Materials Science and Engineering (EMSE 228)</td>
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<td>Polymer Properties and Design (EMAC 276)</td>
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Third Year

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<th>Course Description</th>
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<tr>
<td>Materials for Electronics and Photonics (EMSE 343)</td>
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<tr>
<td>Humanities/Social Science II**</td>
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<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)**</td>
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<td>Materials Laboratory II (EMSE 320)</td>
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<td>Structural Materials by Design (EMSE 372)</td>
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<tr>
<td>Concentration IIa</td>
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<tr>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**</td>
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<td>Materials Laboratory III (EMSE 330)</td>
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<tr>
<td>Processing and Manufacturing of Materials (EMSE 319)</td>
<td>3</td>
<td></td>
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<tr>
<td>Thermodynamic Stability and Rate Processes (EMSE 327)</td>
<td>3</td>
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<tr>
<td>Professional Communication for Engineers (ENGL 398) &amp; Professional Communication for Engineers (ENGR 398)**</td>
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<tr>
<td>Year Total:</td>
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Fourth Year

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<tr>
<th>Course Description</th>
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<tbody>
<tr>
<td>Concentration IVa</td>
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<tr>
<td>Meso-scale Science Including Nanotechnology (EMSE 328)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Senior Project in Materials I (EMSE 398)</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Year Total: 16 14

Total Units in Sequence: 129

Hours required for graduation: 129
* University general education requirement
** Engineering general education requirement
a Actual courses and sequence will vary depending on the concentration chosen; see "Concentrations."
b This requirement may also be met by a minimum of two credits selected from EMSE 260 or EMSE 325.

Cooperative Education (http://engineering.case.edu/coop)
Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

Five-Year Combined BS/MS Program
This program offers outstanding undergraduate students the opportunity to obtain an MS degree, with a thesis, in one additional year of study beyond the BS degree. (Normally, it takes two years beyond the BS to earn an MS degree.) In this program, an undergraduate student can take up to 9 credit hours that simultaneously satisfy undergraduate and graduate requirements. Students considering the combined BS/MS Program should use the Advanced Materials Science concentration, and should select their concentration in consultation with their departmental academic advisor. Typically, students in this program start their research leading to the MS thesis in the fall semester of the senior year. The BS degree is awarded at the completion of the senior year.

Application for admission to the five year BS/MS program is made after completion of five semesters of course work. Minimum requirements are a 3.2 grade point average and the recommendation of a faculty member of the department. Interested students should contact Professor Peter Lagerlöf. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).
Minor in Materials Science and Engineering

In addition to the Bachelor of Science degree program in materials science and engineering, the department also offers a minor in materials science and engineering. This sequence is intended primarily for a student majoring in science or engineering, but it is open to any student with a sound background in introductory calculus, chemistry, and physics. This program requires the completion of EMSE 276 Materials Properties and Design and a minimum of 12 additional credit hours of EMSE courses, including no more than 3 credits of EMSE 125 Freshman Research in Materials Science and Engineering and EMSE 325 Undergraduate Research in Materials Science and Engineering, and no more than 6 credits of one- or two-credit courses. Professor Mark De Guire (mark.deguire@case.edu) (510 White, 368.4221) will assist EMSE minors with course selection.

Minor in Applied Data Science

This undergraduate Minor in Applied Data Science (ADS), based in the Case School of Engineering, is available as a minor to students across CWRU. The minor is directed to students studying in the domains of Engineering and Physical Sciences (including Energy and Manufacturing, Astronomy, Geology, Physics, Health (including Translational and Clinical), and Business (including Finance, Marketing, and Economics). Successful completion of the ADS minor requirements leads to a "Minor in Applied Data Science" for the graduating student. The ADS minor represents that the students have developed knowledge of the essential elements of Data Science and Analytics in the area of their major (their domain of expertise).

Elements of the ADS minor:

The minor is structured so that the students who qualify for the minor have a working understanding of the basic ADS tools and their application in their domain area. This includes:

1. Data Management: datastores, sources, streams;
2. Distributed Computing: local computer, distributed computing such as Hadoop or other cloud computing;
3. Informatics, Ontology, Query: including search, data assembly, annotation; and
4. Statistical Analytics: tools such as R statistics and high level scripting languages (such as Python).

The data types found in these domains are diverse. They include time series and spectral data for Energy and Astronomy, and sensor and production data and image and volumetric data for Manufacturing. In Health, Translational ADS includes Genomic, Proteomic and other Omics data, while Clinical ADS includes patient data, medical data, physiological time series, and mobile data. Business data types include stock and other financial market data for Finance, time series and cross section data for Economics, and operations and consumer behavior data for Marketing.

Students will develop comprehensive experience in the steps of data analysis. Can the steps be formatted as a bulleted or numbered list?

- Step 1: define the ADS questions, and
- Step 2: identify, locate, and/or generate the necessary data, including defining the ideal data set and variables of interest, determining and obtaining accessible data and cleaning the data in preparation for analysis.
- Step 3: exploratory data analysis to start identifying the significant characteristics of the data and information it contains.
- Step 4: statistical modeling and prediction, including interpretation of results, challenging results, and developing insights and actions.
- Step 5: synthesizing the results in the context of the domain and the initial questions, and writing this up.
- Step 6: the creation of reproducible research, including code, datasets, documentation and reports, which are easily transferable and verifiable.

The ADS minor curriculum

The curriculum is based on five 3-credit courses, with one class chosen from each of Levels 1 through Level 5, which cover the spectrum of learning needed to achieve domain area expertise in data science and analytics. The courses are chosen to be both cross-cutting, i.e., intermixing students from across the university in the fundamental ADS concepts such as scripting and statistics (Levels 1, 2, and 4), and domain-focused (Levels 3 and 5). For the Level 4 undergraduate research course, the research topic will be approved by the ADS minor advisor, and will also be a 3-credit project. This will provide ADS minor students both the domain focused ADS learning they need, and a broadening perspective on applications, methods, and uses of ADS in other domains.

Courses Counted Toward ADS Minor Requirements

Established courses included in the ADS Minor are found in Case School of Engineering (Materials Science, Electrical Engineering and Computer Science, Manufacturing), CAS (Mathematics, Astronomy, Philosophy); SOM, SON, and WSOM (Marketing, Finance, Operations, and Economics).

The courses that meet the requirements for the ADS Minor can also be taken by students to meet requirements in Major programs, and therefore serve a dual purpose in our academic offerings. However, each program, department and school may have its own criteria on whether a given course could be “double counted” towards major and minor requirements.

Level 5:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BAFI 361</td>
<td>Applied Financial Analytics</td>
<td>3</td>
</tr>
<tr>
<td>ECON 327</td>
<td>Advanced Econometrics</td>
<td>3</td>
</tr>
<tr>
<td>MKMR 308</td>
<td>Measuring Marketing Performance</td>
<td>3</td>
</tr>
<tr>
<td>MKMR 310</td>
<td>Marketing Analytics</td>
<td>3</td>
</tr>
<tr>
<td>SYBB 459</td>
<td>Bioinformatics for Systems Biology</td>
<td>3</td>
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Level 4:

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<tbody>
<tr>
<td>ASTR 369</td>
<td>Undergraduate Research</td>
<td>1 - 3</td>
</tr>
<tr>
<td>DSCI 352</td>
<td>Applied Data Science Research</td>
<td>3</td>
</tr>
<tr>
<td>EMSE 325</td>
<td>Undergraduate Research in Materials Science and Engineering</td>
<td>1 - 3</td>
</tr>
<tr>
<td>SYBB 387</td>
<td>Undergraduate Research in Systems Biology</td>
<td>1 - 3</td>
</tr>
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Level 3:

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<tbody>
<tr>
<td>DSCI 351</td>
<td>Exploratory Data Science</td>
<td>3</td>
</tr>
<tr>
<td>MKMR 201</td>
<td>Marketing Management</td>
<td>3</td>
</tr>
<tr>
<td>SYBB 311A</td>
<td>Survey of Bioinformatics: Technologies in Bioinformatics</td>
<td>1</td>
</tr>
<tr>
<td>SYBB 311B</td>
<td>Survey of Bioinformatics: Data Integration in Bioinformatics</td>
<td>1</td>
</tr>
</tbody>
</table>
A student must pass satisfactorily a general examination (or a series of examinations) before proceeding. Transfer credit is limited to not more than 6 semester hours. A cumulative GPA of 2.75 or higher is required for graduation. Students with a cumulative GPA less than 2.75 will be placed on academic probation. Transfer of credit from another university is limited to six credit hours of graduate level courses (with grade B or better) taken in excess of B.S. degree requirements at the other university.

A Planned Program of Study (PPOS) must be submitted by the end of the second semester for Plan A and for Plan B students. The PPOS should be prepared by the student and his/her advisor and submitted online to the School of Graduate Studies.

### Accelerated 1-Year M.S. in Materials Science and Engineering with a focus on data science

Materials science and engineering is a discipline that extends from the basic science of materials micro-structure and properties to the design and evaluation of materials in engineering systems. Data science and analytics seeks to identify statistically significant relationships, model development, and predictive behavior of large data sets generated by e.g. manufacturing technologies. This suggested course of study, which extends classical education in materials science and engineering with data science and analytics, can be completed in one calendar year.

The Department of Materials Science and Engineering (DMSE) at Case Western Reserve University (CWRU) is a research-centered educational environment whose mission is to enhance the productivity, quality, and benefit of materials-related learning to its students, faculty, and community. DMSE bears a commitment to the improvement of materials technology, DMSE is equipped with state-of-the-art facilities for mechanical characterization as well as micro-characterization of materials (conventional and advanced methods of electron microscopy and spatially resolved surface analysis). The synergy of these facilities and applying them to a broad spectrum of cutting-edge materials research consistently thrust us among the top tiers of materials research institutions in the nation.

The suggested course of study includes nine (9) courses taken over three semesters: Fall Semester, Spring Semester, and Summer Semester.

#### Fall Semester
- 1. Thermodynamics of Solids
- 2. Structure of Materials

#### Spring Semester
- 4. Phase Transformations, Kinetics and Microstructure
- 5. Properties of Materials
- 6. World Perspective on Materials, and 7. Data Science Modeling, Prediction & Statistical Learning

#### Summer Semester

### PhD Degree Requirements

Immediately upon entering the department, the Ph.D. candidate normally will:

- Fill out and submit the first part of the Planned Program of Study (PPOS) & Supplementary Form
- Register for 2 classes during the first semester
- Register for EMSE 701 Dissertation Ph.D. (usually 3 credit hours) during the first semester. Note that registration for EMSE 701 is not permitted before the Planned Program of Study form is turned in.

As specified in the University General Bulletin section of the School of Graduate Studies: "In order to meet the requirements for the doctorate, a student must pass satisfactorily a general examination (or a series of
examinations covering different fields) specified and administered by the student's department or supervising committee."

Candidates for a Ph.D. degree in Materials Science and Engineering must pass a two-part General Exam. The first part is a Comprehensive Exam and the second part is a Thesis Proposal Evaluation. A cumulative GPA of 3.0 or higher for courses taken at Case Western Reserve University is required to register to take the Comprehensive Exam.

**PhD Comprehensive Exam**

Full-time students entering with an M.S. degree are required to take the Ph.D. Comprehensive Exam within one year. Full-time students entering with a B.S. degree must take the Ph.D. Comprehensive Exam within two years of entering the Ph.D. program. Part-time students must complete the exam prior to accumulating ten or more credit hours. The exam will be offered twice per year at roughly six-month intervals, typically in January and June. The exam will consist of a written test covering specific areas of materials science and engineering.

The exam has multi-part questions that cover the following four areas:

1. Structure (EMSE 503)
2. Thermodynamics (EMSE 504)
3. Phase Transformations (EMSE 505)
4. A Synthesis Area: which combines concepts from the first three areas as they apply to performance of materials Functional Materials..

Students who achieve a score of 70 or above on three of the completed questions and an overall average of 75 or above will pass outright. Students who do not achieve this on their first attempt of the written exam will have one more opportunity to take the Comprehensive Exam the next time the department offers it.

**Thesis Proposal Evaluation**

The Thesis Proposal Evaluation must occur in the semester immediately following the successful completion of the Ph.D. Comprehensive Exam unless a petition, supported by their research advisor, is approved by the graduate studies committee. The Thesis Proposal Evaluation tests the more specific knowledge of the Ph.D. candidate concerning the science underlying the proposed research and the candidate's intellectual maturity. It is composed of a written and an oral evaluation, both dealing with the candidate's proposed research project and specialized courses taken in support of their research program. Both should include a literature search, analysis of the research problem, suggested research procedures, and the general results to be expected. The student's dissertation advisory committee will examine the document for this purpose. The written document must be submitted to the student's dissertation advisory committee at least one week prior to the oral evaluation. Both parts of the Thesis Proposal Evaluation will be graded Pass/Fail.

Upon passing both the Comprehensive Exam and the Thesis Proposal Evaluation, a student will advance to Ph.D. Candidacy.

**PhD Program of Study (Course Requirements)**

A Ph.D. student must take a minimum of 18 credit hours of EMSE 701 and must continue registration each subsequent regular semester (Fall and Spring) until the dissertation is complete, unless granted a leave of absence. The time limit for the Ph.D. program is 5 years for full-time students, starting with the first semester of EMSE 701 registration.

The minimum course requirement for a Ph.D. degree is 12 courses (36 credit hours) beyond the B.S. level, out of which at least 6 courses (18 credit hours) must be taken at Case Western Reserve University. Of these 12 courses, 4 courses must satisfy the Breadth Requirement and 2 courses must satisfy the Basic Science Requirement for the department as outlined below. In the case of a student entering with a M.S. degree from another discipline, additional courses may be required at the discretion of the student’s academic advisor. A GPA of 3.0 is required for graduation. Students with a cumulative GPA below 3.0 will be placed on academic probation.

**MSE Core Sequence:** The Materials Science and Engineering Core sequence consists of:

- EMSE 503 Structure of Materials
- EMSE 504 Thermodynamics of Solids
- EMSE 505 Phase Transformation, Kinetics, and Microstructure

The Core is a required part of the Program of Study for all Ph.D. students. Transfer credit for comparable graduate courses taken at another institution will be allowed on a case-by-case basis. Students may find it helpful to complete the core sequence prior to taking the Ph.D. comprehensive exam.

**Breadth Requirement:**

The Breadth Requirement for the Ph.D. can be fulfilled by taking a total of 4 courses (12 credit hours) within the Case School of Engineering selected in consultation with the student’s advisor.

**Basic Science Requirements:**

A minimum depth in basic science of 2 courses (6 credit hours) is required for a Ph.D. degree. This requirement can be fulfilled by taking 2 courses at the 400 or 500 level selected from Physics, Chemistry, Biology, Mathematics and/or Statistics, and/or certain engineering curricula approved by the department Graduate Studies Committee. Engineering courses used to meet this requirement must be approved prior to enrolling in the course (the deadline being the conclusion of add/drop in any given semester). Students making such a request are required to submit a petition to the department Graduate Studies Committee that justifies the role of the stipulated course as basic, rather than applied, science. Such petitions are expected to be brief. Courses that are not approved as meeting the basic science requirement may be applicable to the breadth requirement.

The PPOS, a list of the courses the student will take to fulfill the Ph.D. requirements, will be discussed and updated if needed at the time of the Thesis Proposal Evaluation.

Upon successful completion of all requirements and research, the Ph.D. candidate must submit a written dissertation as evidence for their ability to conduct independent research at an advanced level. The Ph.D. candidate must pass a final oral exam in defense of the dissertation. The dissertation committee must consist of at least three faculty members from the department and one non-departmental member. The candidate must provide each committee member with a copy of the completed dissertation at least 10 days before the exam, so that the committee members may have an opportunity to read and discuss it in advance.

**Facilities**

**Materials Processing**

The department's processing laboratories include facilities which permit materials processing from the liquid state (casting) as well as in the solid state (powder processing). The department has its own foundry that houses mold making capabilities (green and bonded sand, permanent
mold, and investment casting), induction melting furnaces of various capabilities for air melting of up to 1500 pounds of steel, electrical resistance furnaces for melting and casting up to 800 pounds of aluminum, and 500 pounds of magnesium under protective atmosphere, a dual chamber vacuum induction melting unit with a capacity of up to 30 pounds of superalloys, a 350 ton squeeze casting press, and state-of-the-art thermal fatigue testing and characterization equipment. The Crystal Growth Laboratory has facilities for production of high purity electronic single crystals using a variety of furnaces with the additional capability of solidifying under large magnetic fields. In addition, a CVD and MOCVD reactor has been set up to do research on the growth of SiC and GaN on Si, sapphire, and other substrates. Secondary processing and working can be accomplished using a high-speed hot and cold rolling mill, swaging units, and a state-of-the-art hydrostatic extrusion press. The department has heat treatment capabilities including numerous box, tube, and vacuum furnaces. For the processing of powder metals or ceramics the department possesses a 300,000 pound press, a vacuum hot press (with capabilities of up to 7 ksi and 2300 C), a hot isostatic press (2000 C and 30 ksi), a 60 ksi wet base isostatic press, and glove boxes. Sintering can be performed in a variety of controlled atmospheres while a microcomputer-controlled precision dilatometer is available for sintering studies. Several ball mills, shaker mills, and a laboratory model attritor are also available for powder processing. In addition, facilities are available for sol-gel processing, glass melting, and diamond machining; a spray dryer is available for powder granulation.

A Deformation Processing Laboratory has recently been commissioned that contains two dual hydraulic MTS presses. The first press is designed to evaluate the stretching and drawing properties of metals in sheet form. Its maximum punch and hold down forces are 150,000 each. Its maximum punch velocity is 11.8 inch/sec. The second press is designed to evaluate the plastic flow behavior of materials in an environment that simulates modern manufacturing processing. The press can deliver up to five consecutive impacts to a material in less than five seconds with a punch velocity as high as 110 inch/sec. The maximum punch force is 110,000 pounds.

Advanced Manufacturing and Mechanical Reliability Center (AMMRC)

The Advanced Manufacturing and Mechanical Reliability Center (AMMRC) permits the determination of mechanical behavior of materials over loading rates ranging from static to impact, with the capability of testing under a variety of stress states under either monotonic or cyclic conditions. A variety of furnaces and environmental chambers are available to enable testing at temperatures ranging from -196 C to 1800 C. The facility is operated under the direction of a faculty member and under the guidance of a full-time engineer. The facility contains one of the few laboratories in the world for high-pressure deformation and processing, enabling experimentation under a variety of stress states and temperatures. The equipment in this state-of-the-art facility includes:

High Pressure Deformation Apparatus: These units enable tension or compression testing to be conducted under conditions of high hydrostatic pressure. Each apparatus consists of a pressure vessel and diagnostics for measurement of load and strain on deforming specimens, as well as instantaneous pressure in the vessel. Pressures up to 1.0 GPa loads up to 10kN, and displacements of up to 25 mm are possible. The oil based apparatus is operated at temperatures up to 300°C room temperature while a gas (i.e. Ar) based apparatus is used at room temperature.

Hydrostatic Extrusion Apparatus: Hydrostatic extrusion (e.g. pressure-to-air, pressure-to-pressure) can be conducted at temperatures up to 300 C on manually operated equipment interfaced with a computer data acquisition package. Pressures up to 2.0 GPa are possible, with reduction ratios up to 6 to 1, while various diagnostics provide real time monitoring of extrusion pressure and ram displacement.

Advanced Forging Simulation Rig: A multi-actuator MTS machine based on a 330 kip, four post frame, enables sub-scale forging simulations over industrially relevant strain rates. A 110 kip forging actuator is powered by five nitrogen accumulators enabling loading rates up to 120 inches/sec on large specimens. A 220 kip indexing actuator provides precise deformation sequences for either single, or multiple, deformation sequences. Date acquisition at rates sufficient for analysis is available. Testing with heated dies is possible.

Advanced Metal Forming Rig: A four post frame with separate control of punch actuator speed and blank hold down pressure enables determination of forming limit diagrams. Dynamic control of blank hold down pressure is possible, with maximum punch actuator speeds of 11.8 inches/sec. A variety of die sets are available.

The remainder of the equipment in the AMMRC is summarized below:

Servo-hydraulic Machines: Four MTS Model 810 computer-controlled machines with load capacities of 3 kip, 20 kip, 50 kip, and 50 kip, permit tension, compression, and fatigue studies to be conducted under load-, strain-, or stroke control. Fatigue crack growth may be monitored via a dc potential drop technique as well as via KRAK gages applied to the specimen surfaces. Fatigue studies may be conducted at frequencies up to 30 Hz. In addition, an Instron Model 1331 20 kip Servo-hydraulic machine are available for both quasi-state and cyclic testing.

Universal Testing Machines: Three INSTRON screw-driven machines, including two INSTRON Model 1125 units permit tension, compression and torsion testing.

Electromechanical Testing Machine: A computer-controlled INSTRON Model 1361 can be operated under load-, strain-, or stroke control. Stroke rates as slow as 1 micrometer/hour are possible.

Fatigue Testing Machines: Three Sonntag fatigue machines and two R. R. Moore rotating-bending fatigue machines are available for producing fatigue-life (S-N) data. The Sonntag machines may be operated at frequencies up to 60 Hz.

Creep Testing Machines: Three constant load frames with temperature capabilities up to 800 C permit creep testing, while recently modified creep frames permit thermal cycling experiments as well as slow cyclic creep experiments.

Impact Testing Machines: Two Charpy impact machines with capacities ranging from 20 ft-lbs to 240 ft-lbs are available. Accessories include a Dynatup instrumentation package interfaced with an IBM PC, which enables recording of load vs. time traces on bend specimens as well as on tension specimens tested under impact conditions.

Instrumented Microhardness Tester: A Nikon model QM High-Temperature Microhardness Tester permits indentation studies on specimens tested at temperatures ranging from -196 C to 1600 C under vacuum and inert gas atmospheres. This unit is complemented by a Zwick Model 3212 Microhardness Tester as well as a variety of Rockwell Hardness and Brinell Hardness Testing Machines.
The Swagelok Center for Surface Analysis of Materials (SCSAM)

The Swagelok Center for Surface Analysis of Materials (SCSAM) is a multi-user facility providing cutting-edge major instrumentation for microcharacterization of materials. SCSAM’s instruments encompass a wide and complementary range of characterization techniques, which provide a comprehensive resource for high-resolution imaging, diffractometry, and spatially-resolved compositional analysis.

Current capabilities for SEM (scanning electron microscopy) include four scanning electron microscopes, three of which are equipped for FIB (focused ion beam) micromachining, XEDS (X-ray energy-dispersive spectrometry), and acquisition of EBSP (electron backscattering patterns). SCSAM operates a 300 kV high-resolution transmission electron microscope, equipped with field-emission gun and imaging energy filter. This instrument is capable of XEDS and EELS (electron energy-loss spectrometry). SCSAM’s SPM (scanning probe microscopy) capabilities include a UHV (ultra-high vacuum) variable-temperature atomic-resolution system for STM (scanning tunneling microscopy), STS (scanning tunneling spectroscopy), and all models of AFM (atomic-force microscopy), as well as a standard instrument for AFM, which can optionally be operated with a scanning nannoindenter. A stand-alone automated nanoindenter is available as well. SCSAM also operates a laser scanning confocal optical microscope, dedicated to imaging inorganic materials and capable of performing Raman microscopy. For XRD (X-ray diffractometry), SCSAM provides 3 diffractometers capable of a variety of techniques. SCSAM’s surface analysis suite of instruments includes an instrument for ToF-SIMS (time-of-flight secondary-ion mass spectrometry), a SAM (scanning Auger microprobe) for spatially resolved AES (Auger electron spectrometry), and an instrument for XPS (X-ray photoelectron spectrometry, also known as ESCA, electron spectrometry for chemical analysis), that accomplishes high spatial resolution by operating with a focused X-ray beam.

SCSAM is administered directly by the CSE (Case School of Engineering) and is central to much of the research carried out by CSE’s seven departments. However, the facility is also extensively used by the CAS (College of Arts and Sciences) Departments of Physics, Chemistry, Biology, and Earth, Environmental, and Planetary Sciences, as well as many departments within the School of Medicine and the School of Dental Medicine. In addition to CWRU clients, many external institutions utilize SCSAM’s facilities, including NASA Glenn Research Center, the Cleveland Clinic, and numerous Ohio universities. More than 250 users utilize the facility in any given year.

SCSAM’s instruments are housed in a centralized area, allowing users convenient access to state-of-the-art tools for their research.

Transmission Electron Microscopy Laboratory

A transmission electron microscope is available that provides virtually all conventional and advanced microscopy techniques required for state-of-the-art materials research and involves an installed capacity worth $2,500,000.

The FEI Tecnai F30 300 kV field-emission gun energy-filtering high-resolution analytical scanning transmission electron microscope has a point resolution below 0.20 nm and an information resolution limit of 0.14 nm. The instrument is equipped with an EDAX system with a high-energy resolution Si-Li detector for XEDS (X-ray energy-dispersive spectrometry), a HAADF (high-angle annular dark-field) detector for STEM (scanning transmission electron microscopy), and a Gatan GIF 2002 imaging energy filter including a 2 k-by-2 k pixel slow-scan CCD camera. The GIF in conjunction with the field-emission gun enable EELS (electron energy-loss spectrometry) with an energy resolution down to below 1 eV. Further, the instrument is equipped with a NanoMegas TopSpin system for grain-orientation mapping and related techniques.

Conventional TEM techniques, such as bright-field and dark-field imaging, electron diffraction, or weak-beam dark-field imaging are used routinely to analyze line defects (dislocations) and planar defects (interfaces, grain boundaries, stacking faults) in crystalline materials. Advanced TEM techniques include the following:

- High-resolution TEM. This technique enables imaging the projected atomistic structure of extended crystal defects, such as heterophase interfaces, grain boundaries, or dislocations.
- CBED (convergent-beam electron diffraction). This technique can be used to obtain crystallographic information (space group) and to determine orientation relationships between small (even nanoscopic) crystallites.
- EFTEM (energy-filtering TEM). This denotes a suite of techniques enabled by an imaging energy filter. In particular, the techniques include zero (energy)-loss filtering for improved contrast in images and diffraction patterns and ESI (electron spectroscopic imaging), a technique that enables rapid elemental mapping with high spatial resolution based on element-characteristic energy losses of the primary electrons in the specimen. Specimen preparation facilities for TEM, in addition to the FIB systems described above, consist of two dimple-grinders, two electropolishing units, two state-of-the-art PIPS (precision ion polishing systems) by Gatan, and a Fischione NanoMill 1040 for highest-quality specimens by post-processing of FIB-prepared foils.

Scanning Electron Microscopy Laboratory

SEM (scanning electron microscopy) provides valuable specimen information by enabling imaging with particularly great depth of field and stereo-imaging with resolutions down to the nanometer range. The topography of nearly any solid surface is possible with SEM. Spectrochemical studies are enabled by XEDS (X-ray energy-dispersive spectrometry) systems capable of detecting elements from boron to uranium. The laboratory houses the following instruments:

- The xT Nova Nanolab 200 (FEI), a dual-beam system providing a FIB (focused ion beam) and a scanning electron beam. The focused ion beam is used for preparing thin foils suitable for TEM directly out of the specimen surface. At the same time, enabled by the scanning electron beam, this instrument includes a complete and very-high-quality scanning electron microscope. This construction has the advantage that the specimen can be observed by (high-resolution) SEM while being milled by the ion beam. Moreover, the Nova includes an internal “lift-out-” system for transferring the thin film generated by ion-beam milling onto a special Cu support grid, which can then be loaded into the specimen holder of a TEM. For elemental and crystallographic analysis, the system is equipped with a state-of-the-art Oxford AZtec system with a X-max 50mm² detector and a NORDLYS EBSP camera. EBSD mapping of phase and orientation relies on evaluating EBSP patterns of every scan point and can be run on bulk materials and in transmission mode on TEM samples.
- The FEI Quanta 200 3D. This is a versatile low-vacuum SEM/FIB for 2D and 3D material characterization and analysis. It features three imaging modes: high-vacuum, low-vacuum, and ESEM, and can
accommodates a wide range of samples. The instrument is equipped with a field-emission Ga ion source and a thermal electron emitter. The enabling technologies, integrated onto a single platform, further include high-volume milling capabilities, an ESEM differential-pumping variable-pressure vacuum system (oil-free), gaseous secondary and backscattered electron detectors for imaging and analysis in a gaseous chamber environment, a high-precision specimen goniometer with 50 mm travel along the x- and y-axis, and automation serving unattended sectioning with full access to e-beam, i-beam, and patterning.

- A Helios NanoLab™ 650, features FEI's most recent advances in field-emission SEM and FIB (focused ion beam) technologies and their combined use. It is designed to access a "new world" of extremely high-resolution 2D and 3D characterization, 3D nano-prototyping, and higher quality TEM sample preparation. The Helios's capability of robust and precise FIB slicing, combined with a high-precision piezo stage (150 x 150 mm2), superb SEM performance, and advanced software allow unattended sample preparation or 3D characterization and analysis. The outstanding imaging capabilities of the Helios NanoLab begin with its Elstar™ FESEM. Thanks to its integrated monochromator (UC) and beam deceleration, it delivers sub-nanometer resolution across the whole 1-30 kv range. The Elstar features other unique technologies such as constant power lenses for higher thermal stability and electrostatic scanning for higher deflection linearity and speed. Its through-the-lens detector, set for highest collection efficiency of SE (secondary electrons) and on-axis BSE (backscattered electrons), is complemented by FEI's advanced detection suite including three novel detectors: two multi-segment solid state detectors: CBS retractable detector for backscattered electron imaging able to detect low kv BSE, a scanning transmission electron mode retractable detector able to record simultaneously BF, DF and HAADF images, and a third dedicated to FIB-SE and -Si (secondary ion) imaging. The Helios system is equipped with a state-of-the-art XEDS X-Max 80 mm2 silicon drift detector (SDD) system by Oxford with an energy resolution of 125 eV at Mn Kα (5.899 keV) at full width at half maximum. The extremely large active area significantly increases the collection solid angle. This results in a detector that performs measurements either more quickly at conditions at which traditional systems would be used or at higher energy resolution. The increased sensitivity allows the system to operate at much lower beam currents. This reduces the risk of sample damage.

**Surface Science Laboratories**

SCSAM's tools for surface science include three instruments for surface analysis in UHV (ultra-high vacuum), two scanning probe systems, and a dedicated nanoindenter, all detailed below:

- A PHI 680 scanning Auger microprobe. This system consists of a field-emission scanning electron microscope with a Schottky emission cathode, a secondary electron detector, and an axial cylindrical mirror analyzer with a multi-channel detector to collect Auger electrons produced during electron imaging. Very small spot sizes can be realized with this instrument, down to 7 nm. This is useful for high-resolution imaging and for Auger data acquisition using low beam currents. Inert gas sputtering (using a PHI 06-350 ion gun) is used to clean surface contamination from samples and to remove material from a small area on the surface for depth profiling. Several modes of operation are available to the user, including survey, line, profile, and elemental mapping. Capable of multi-point analysis, the instrument is a powerful tool for routine failure analysis and quality control of inorganic samples. An additional device permits in situ fracture of samples, at liquid nitrogen temperature if necessary.

- A PHI VersaProbe XPS Microprobe. Based on XPS (X-ray photoelectron spectrometry, also known as ESCA – electron spectrometry for chemical analysis), this is a multi-technique surface analysis instrument based on PHI's highly developed scanning X-ray microprobe technology. The most important advantage of this instrument is that the VersaProbe can produce a focused, highly monochromatic X-ray beam that can be scanned over the specimen surface. In this instrument, a point source of X-rays is created by focusing an electron beam onto an Al anode. A monochromator, consisting of an ellipsoid-shaped crystal, collects X-rays from the point source and focuses them on the surface of the specimen. The focused X-ray beam can be scanned across the specimen surface by correspondingly scanning the electron beam across the surface of aluminum anode. A major advantage of this design is that most of the photoelectrons generated by the focused X-ray beam are actually collected by the electron energy analyzer, whereas in the conventional design, most of the photoelectrons are lost. With the VersaProbe, the spot size can be varied between less than 10 μm diameter (for highest spatial resolution) to 100 μm (for highest sensitivity).

- A TRIFT V nanoTOF made by PHI. This is a time-of-flight secondary-ion mass spectrometer. This instrument is from the latest generation of PHI’s surface analysis line of ToF-SIMS instruments, utilizing a newly developed, high-quality “TRIFT” analyzer. It is equipped with a Au-, a C60-, and an Ar gun. An innovative new sample handling platform enables analysis of samples with complex geometries. In addition, the system has state-of-the-art charge compensation and ion gun performance.

ToF-SIMS (time-of-flight secondary-ion mass spectrometry) provides sub-micrometer 3D (!) elemental mapping. It can also be used to image the topography of solid surfaces. Different from D-SIMS (“dynamic” SIMS), ToF-SIMS enables analyzing the outermost one or two mono-layers of a sample while basically preserving molecular integrity. While D-SIMS provides primarily elemental information, ToF-SIMS surface analysis yields chemical and molecular information. ToF-SIMS is ideal for both organic and inorganic materials and can be used to characterize both insulating and conductive samples. With detection limits in the ppm to ppb range, shallow depth profiling capabilities and automated analysis, the nanoTOF can be used to study surface contamination, trace impurities, films, delamination failures etc. It is also a valuable tool to investigate surface modification chemistry and catalyst surface composition.

- A Dimension 3100 (Veeco Digital Instruments). This is a state-of-the-art multi-mode scanning probe microscope (SPM), equipped with a NanoScope IIIa controller and Quadrex signal processor for 16-bit resolution on all 3 axes. The tool works under atmospheric pressure at room temperature and can work in air and in liquids, so that a full range of materials (metals, insulators, ceramics, polymers, and biological specimens) can be investigated with minimal sample preparation. It can accept samples up to 20 cm in diameter, with a height limitation of < 1.5 cm and a surface roughness limitation of < 5.5 μm. The instrument is equipped with an in-line optical zoom microscope with color CCD camera, with a maximum magnification of 800X for precise placement of the SPM probe onto the sample. The Dimension 3100 can operate in numerous imaging modes, the primary operation being atomic force microscopy (AFM) in
contact mode, tapping mode, and phase imaging mode. Other data collection techniques include conductive-AFM to characterize conductivity variations, magnetic force microscopy, which uses a ferromagnetic-coated tip to probe magnetic fields, and force-distance measurements, which are performed to study attractive and repulsive forces on a tip as it approaches and retracts from the sample surface. Further, the Dimension 3100 SPM has been upgraded by a “TriboScope,” an attachment for nanomechanical testing, made by Hysitron. The TriboScope is a quantitative, depth-sensing nanoindentation and nanoscratch system that interfaces with the SPM. This attachment enables quantitative characterization of mechanical properties (hardness, scratch resistance, wear resistance) on the nanometer length scale and in situ AFM imaging of the surface topography before and after mechanical testing. The capability of in situ imaging allows the user to choose the exact area, with sub-nm precision, for each nanoindentation/nanoscratch investigation, and to fully characterize the local specimen surface.

- An RHK 7500 UHV VT. This system includes a variable-temperature ultra-high vacuum scanning probe microscope, made by RHK Technologies. This instrument is part of a complete UHV (ultra-high vacuum) system, which includes a separately pumped specimen preparation chamber and a load-lock chamber in addition to the actual SPM (scanning probe microscope) chamber. The base pressure of the system is specified to 2.10^{-12} Pa. In the preparation chamber, an electron gun combined with a hemispherical electron energy analyzer is attached to enable chemical analysis of the specimen surface via AES (Auger electron spectroscopy). A specimen manipulator installed on the vertical axis of the chamber allows precise positioning of the specimen in front of the electron energy analyzer. The manipulator can be connected to a cryostat via a differentially-pumped rotary stage, permitting cooling the specimen down to 25 K. By resistive or electron-beam heating, it will also be possible to heat the specimen up to temperatures of 1500 K.

To be able to clean the specimen surface, the system includes an Ar sputter gun. Evaporators installed at ports in the lower half of the chamber enable the deposition of metals onto the specimen surface. A gas dosing system facilitates gas adsorption experiments without backfilling the entire chamber or opening the main chamber to change gases. A mass spectrometer constantly detects and analyzes residual gas in the chamber. Finally, the preparation chamber includes a port large enough for a retractable reverse view LEED (low-energy electron diffraction) system for studying the surface structure of the specimen.

Using a magnetic transfer arm, the specimen can be moved from the preparation chamber into the actual SPM chamber. This chamber houses a cantilever atomic force microscope combined with a scanning tunneling microscope, suitable to image the surface structure of conducting as well as non-conducting materials. Both instruments are capable of atomic-resolution imaging. The scanning tunneling microscope also permits probing the local work function and the local density of states in the specimen surface by STS (scanning tunneling spectrometry). All modes of SPM will work over a very broad range of specimen temperatures: 25 to 750 K. The SPM chamber accepts thermal evaporators, a sputter gun and a gas dosing system that can perform their functions while the sample is actively being studied by any of the available scanning probe techniques.

- An Agilent Nano Indenter G200. This is a very accurate, flexible, user-friendly instrument for nanomechanical testing. Electromagnetic actuation allows unparalleled dynamic range in force and displacement and measurement of deformation over six orders of magnitude (from nanometers to millimeters). Potential applications include a wide scope of materials, e.g. semiconductors, films, MEMs (wafer applications), coatings and DLC films, composite materials, fibers, polymers, metals, ceramics, and biomaterials.

### X-Ray Diffractometry Laboratory

The XRD (X-ray diffractometry) laboratory contains equipment for studying the atomic structures of mainly crystalline inorganic materials. Three instruments are available:

- A Scintag X1 diffractometer system. This includes a theta/theta wide-angle goniometer, a 4.0 kW X-ray generator with Cu tube, a third axis stress attachment, a thermoelectrically cooled Peltier Ge detector, a film analysis system, a dedicated PC for data acquisition, and a turbomolecular-pump evacuated furnace attachment permitting sample temperatures up to 1700 K.

- A Bruker Discover D8 X-ray diffractometer. This instrument has a monochromated X-ray source (normally used with a Co-Kα X-ray tube), configured in point-focus mode. X-ray collimators are available for spot sizes from 200 μm to 800 μm, with 500 μm typical. The instrument includes a four-circle Huber goniometer equipped with an xyz stage and a laser video system to allow precision alignment of samples. Enabled by the small spot size of the incident X-ray beam and the precision alignment, small samples sizes can be evaluated and the instrument achieves much higher spatial resolution than conventional X-ray diffractometers. The 2D solid-state detector (VÄNTEC-500) allows a wide range of XRD techniques to be executed in short time. The detector has high sensitivity and is useful for detecting trace phases that might be missed by a conventional diffractometer. In addition, the detector allows rapid measurements of both stress and texture in a wide variety of materials. Software includes Diffrac.EVA for phase identification with the ICDD database and Diffrac.LEPTOS for stress measurement.

- The Rigaku D/Max 2200 Powder X-ray Diffractometer is equipped with a horizontal goniometer, capable of performing typical 8—2θ scans. The scanning speed can be varied from 0.002 °/min to 100 °/min. The divergence, scattering, and receiving slits are fully automated and controlled through a graphical user interface within the software. The D/Max 2200 complements SCSAM’s two other XRD units as it is equipped with a Cu anode. The wavelength of Cr-Kα X-rays (0.229 nm) is suitable for steel alloys that exhibit heavy fluorescence with Cu-Kα X-rays (0.154 nm). In addition, the larger wavelength is preferred when trying to determine small changes in the lattice parameters, as peaks are shifted to higher 2θ values, which provide greater sensitivity to small changes in the lattice parameter. The sensitivity of the peak shift is ideal for measuring residual stress and determining solvus curves in binary phase diagrams.

### Electronic Properties Laboratory

#### Crystal Growth and Analysis Laboratory

The Crystal Growth and Analysis Laboratory is equipped for research studies and characterization of bulk semiconductor and photonic materials. The growth facilities include a high pressure Czochralski system, low pressure Czochralski system, and a Vertical Bridgman system with magnetic field stabilization. The characterization facilities
include capabilities for sample preparation, a Hall effect system, and an Infra-red microscope.

**Magnetometry Laboratory**

The Magnetometry Laboratory has facilities used to investigate the magnetic properties of materials. This laboratory has two instruments:

- A Lake Shore Cryotronics Model 7410 Vibrating Sample Magnetometer for measurement of hysteresis loops (at constant temperature) and thermomagnetic measurements (at constant magnetic field). The maximum applied field at room temperature (without furnace in place) is 3.1 Tesla. For high temperature measurements, the maximum applied field is 2.5 Tesla over the temperature range from room temperature to 1000°C.
- A home-built magnetostriiction measurement system has been designed and built to measure the shape change of magnetic materials under applied magnetic fields. Better than 1 ppm sensitivity is possible by this strain gage technique. An applied field of ~0.2 Tesla is used to saturate samples.

**Fuel Cell Testing Laboratory**

Facilities (located in the A. W. Smith Building) for testing of solid oxide fuel cells include:

- 2 test stands for 4” cells and small stacks (Fuel Cell Technologies); test temperatures to 1000°C; professional turnkey LabView interface for system control and data acquisition
- 2 test stands for 1” cells; test temperatures to 1000°C; LabView interface for complete system control and data acquisition; Omega mass flow controllers; Keithley and Amrel electronics; AutoLab Electrochemical Analyzer for I-V, galvanostatic or amperometric testing and AC impedance spectroscopy
- All test stands contained in dedicated enclosures rated for use with hydrogen, hydrogen sulfide, and carbon monoxide with ventilation system, leak detection, tank pressure monitors, alarm system
- Dedicated furnaces and ovens for preparing cells for testing

**SDLE Research Center**

The SDLE Research Center was established in 2011 with funding from Ohio Third Frontier, and is dedicated to advancing the field of lifetime and degradation science. The research center activities focus on durability and degradation of environmentally exposed, long lived materials and technologies such as photovoltaics (PV), energy efficient lighting, and building envelope applications. The Center develops real-time and accelerated protocols for exposure to solar radiation and related environmental stressors to enable the evaluation of the environmental durability and lifetime of materials, components, and products. Data scientists identify statistically significant relationships using a data analytics platform (Energy-CRADLE) developed in the center. Researchers perform post-exposure optical and thermo-mechanical measurements to develop quantitative mechanistic models of degradation processes. The SDLE Research Center’s capabilities and equipment include:

- Outdoor solar exposures: SunFarm with 14 dual-axis solar trackers with multi-sun concentrators, and power degradation monitoring
- Solar simulators for 1-1000X solar exposures
- Multi-factor environmental test chambers with temperature, humidity, freeze/thaw, and cycling
- A full suite of optical, interfacial, thermo-mechanical and electrical evaluation tools for materials, components and systems

**The Wind Energy Research and Commercialization (WERC) Center**

The WERC Center is a multidisciplinary center for use by students, faculty, and industry providing instrumentation for wind resource characterization and research platforms in operating wind turbines. The WERC Center was established in 2010 with funding from the Ohio Department of Development Third Frontier Wright Project and the Department of Energy. Additional support was provided by the following inaugural industrial partners: Cleveland Electric Laboratories, The Lubrizol Corporation, Parker Hannifin Corporation, Azure Energy LLC, Rockwell Automation, Inc., Swiger Coil Systems LLC, and Wm. Sopko & Sons Co. The instruments in the WERC Center include:

- A continuous scan ZephIR LiDAR, manufactured by Natural Power. This instrument measures horizontal and vertical wind velocity along with wind direction at 1 Hz frequency at five user set heights up to 200 m.
- Five meteorological measurement systems: 3 on campus; 1 with the off campus wind turbines; and one at the City of Cleveland’s water intake crib located 3.5 miles offshore in Lake Erie.
- An ice thickness sensor that is deployed at the bottom of Lake Erie each fall and retrieved in the spring.
- A NorthWind 100 wind turbine manufactured by Northern Power Systems in Barre, VT, USA. This 100kW community scale wind turbine has a direct drive generator with full power inverters, stall control blades with a 21 m rotor diameter, and a 37 m hub height. This wind turbine is located on campus just east of Van Horn field and began operation in November, 2010.
- A Vestas V-27 wind turbine originally manufactured by Vestas in Denmark. This 225kW medium scale wind turbine has a gearbox drive generator, pitch controlled blades with a 27 m rotor diameter, and a 30 m hub height. In addition it has a 50kW generator for low wind generation. This wind turbine is located at an industrial site in Euclid, OH about 15 minutes from campus and began operation in March, 2012.
- A Nordex N-54 wind turbine originally manufactured by Nordex in Germany. This 1.0MW utility scale wind turbine has a gearbox drive generator, stall control blades with a 54 m rotor diameter, and a 70 m hub height. In addition it has a 200kW generator for low wind generation. This wind turbine is located at an industrial site in Euclid, OH about 15 minutes from campus and began operation in October, 2012.

**EMSE 110. Transitioning Ideas to Reality I - Materials in Service of Industry and Society, 1 Unit.**

In order for ideas to impact the lives of individuals and society they must be moved from “blue sky” to that which is manufacturable. Therein lies true creativity - design under constraint. Greater Cleveland is fortunate to have a diverse set of industries that serve medical, aerospace, electric, and advanced-materials technologies. This course involves trips to an array of work sites of leading companies to witness first-hand the processes and products, and to interact directly with practitioners. Occasional in-class speakers with demonstrations will be used when it is not logistically reasonable to visit off-site.
EMSE 120. Transitioning Ideas to Reality II - Manufacturing Laboratory. 2 Units.
This course complements EMSE 110. In that class students witness a diverse array of processing on-site in industry. In this class students work in teams and as individuals within processing laboratories working with an array of "real materials" to explore the potential of casting, machining, and deformation processes to produce real parts and/or components. An introduction to CAD as a means of communication is provided. The bulk of the term is spent in labs doing hands-on work. Planned work is carried out to demonstrate techniques and potential. Students have the opportunity to work independently or in teams to produce articles as varied as jewelry, electronics, transportation vehicles, or novel components or devices of the students' choosing.

EMSE 125. Freshman Research in Materials Science and Engineering. 1 Unit.
Freshman students conduct independent research in the area of material science and engineering, working closely with graduate student(s) and/or postdoctoral fellow(s), and supervised by an EMSE faculty member. An average of 5-6 hrs/wk in the laboratory, periodic updates, and an end of semester report is required. Prereq: Limited to freshman, with permission of instructor.

EMSE 220. Materials Laboratory I. 2 Units.

EMSE 228. Mathematical Methods for Materials Science and Engineering. 3 Units.
Problems in materials science and engineering drawn from thermodynamics, material property measurements, heat transfer, mass transfer, and failure analysis. Students will develop a fundamental understanding of the basis for solving these problems including understanding the constituent equations, solution methods, and analysis and presentation of results. Students will then solve these problems using current computational tools employed by practicing materials engineers and scientists. Advantages and disadvantages of techniques using spreadsheets, programming languages, and specialized programs. Recommended preparation or recommended co-requisite: MATH 224 or MATH 228. Prereq: EMSE 276 and (ENGR 131 or ECE 132) and (PHYS 121 or PHYS 123) and (MATH 122 or MATH 124).

EMSE 276. Materials Properties and Design. 3 Units.
Relation of crystal structure, microstructure, and chemical composition to the properties of materials. The role of materials processing in controlling structure so as to obtain desired properties, using examples from metals, ceramics, semiconductors, and polymers. Design content includes exercises in materials selection, and in design of materials to meet specified performance requirements. Prereq: MATH 121 and (ENGR 145 or EMSE 146). Prereq or Coreq: PHYS 122 or PHYS 124.

EMSE 307. Foundry Metallurgy. 3 Units.
Introduction to solid-liquid phase transformations and their application to foundry and metal casting processes. Includes application of nucleation and growth to microstructural development, application of thermodynamics to molten metal reactions, application of the principles of fluid flow and heat transfer to gating and risering techniques, and introduction to basic foundry and metal casting technology. Recommended preparation: EMSE 202 and EMSE 203 and ENGR 225.

EMSE 308. Welding Metallurgy. 3 Units.
Introduction to arc welding and metallurgy of welding. The course provides a broad overview of different industrial applications requiring welding, the variables controlling critical property requirements of the weld and a survey of the different types of arc welding processes. The course details the fundamental concepts that govern the different aspects of arc welding including the welding arc, weld pool solidification, precipitate formation and solid state phase transformations. Offered as EMSE 308 and EMSE 408. Coreq: EMSE 327.

EMSE 319. Processing and Manufacturing of Materials. 3 Units.
Introduction to processing technologies by which materials are manufactured into engineering components. Discussion of how processing methods are dependent on desired composition, structure, microstructure, and defects, and how processing affects material performance. Emphasis will be placed on processes and treatments to achieve or improve chemical, mechanical, physical performance and/or aesthetics, including: casting, welding, forging, cold-forming, powder processing of metals and ceramics, and polymer and composite processing. Coverage of statistics and computational tools relevant to materials manufacturing. Prereq: EMSE 276 or EMSE 201.

EMSE 320. Materials Laboratory II. 1 Unit.
Measurement of thermophysical properties of materials emphasizing thermal and electrical properties of materials. Laboratory teams are selected for all experiments. Statistical analysis of experimental results also emphasized. Recommended preparation or corequisite: EMSE 276.

EMSE 325. Undergraduate Research in Materials Science and Engineering. 1 - 3 Units.
Undergraduate laboratory research in materials science and engineering. Students will undertake an independent research project alongside graduate student(s) and/or postdoctoral fellow(s), and will be supervised by an EMSE faculty member. Written and oral reports will be given on a regular basis, and an end of semester report is required. The course can be repeated up to four (4) times for a total of six (6) credit hours. Prereq: Sophomore or Junior standing and consent of instructor.

EMSE 327. Thermodynamic Stability and Rate Processes. 3 Units.
An introduction to thermodynamics of materials as applied to metals, ceramics, polymers and optical/radiant heat transfer for photovoltaics. The laws of thermodynamics are introduced and the general approaches used in the thermodynamic method are presented. Systems studied span phase stability and oxidation in metals and oxides; nitride ceramics and semiconductors; polymerization, crystallization and block copolymer domain formation; and the thermodynamics of systems such as for solar power collection and conversion. Recommended preparation: EMSE 228 and ENGR 225 or equivalent. Prereq: EMSE 276 or EMSE 201.

EMSE 328. Meso-scale Science Including Nanotechnology. 3 Units.
Mesoscale science focuses on addressing the frontiers of complex systems, between quantum and classical, nano and macro, and across the four dimensions of space and time. Nanoscience continues to advance, and multi-scale approaches are used to bridge orders of magnitude in length scales. This course will explore tools that are needed to bridge different length scales, including crystallography (crystal symmetries, point groups, crystal systems and space groups), crystal chemistry, characterization of microstructures (including grains, inclusions, second phases, texture, and voids), diffraction principles and their application in characterizing materials at differing length scales (nano, micro, meso, macro), device characterization methods, and fabrication technologies and processes. Offered as: EMSE 328 and EMSE 428. Prereq: (MATH 223 or MATH 227) and (EMSE 276 or EMSE 201).
EMSE 330. Materials Laboratory III. 2 Units.

EMSE 335. Strategic Metals and Materials for the 21st Century. 3 Units.
This course seeks to create an understanding of the role of mineral-based materials in the modern economy focusing on how such knowledge can and should be used in making strategic choices in an engineering context. The history of the role of materials in emerging technologies from a historical perspective will be briefly explored. The current literature will be used to demonstrate the connectedness of materials availability and the development and sustainability of engineering advances with examples of applications exploiting structural, electronic, optical, magnetic, and energy conversion properties. Processing will be comprehensively reviewed from source through refinement through processing including property development through application of an illustrative set of engineering materials representing commodities, less common metals, and minor metals. The concept of strategic recycling, including design for recycling and waste stream management will be considered. Offered as EMSE 335 and EMSE 435. Prereq: Senior standing or graduate student.

EMSE 343. Materials for Electronics and Photonics. 3 Units.
This course covers the basics of planar processing, which is the foundation of producing semiconductor chips and photonic devices, and the way these devices are incorporated into electronics and display technologies. Basic characteristics of semiconductors and optoelectronic devices; and how advances in these technologies arise from, and drive, advances in materials and device architecture. Offered as: EMSE 343 and EMSE 443. Prereq: (PHYS 122 or PHYS 124) and (EMSE 276 or EMSE 201).

EMSE 345. Materials for Biological and Medical Technology. 3 Units.
A survey of natural biomaterials and synthetic biomedical materials from the perspective of materials science and engineering, focusing on how processing/synthesis, structure, and properties determine materials performance. Structure and properties of bones and teeth, soft tissue, and cartilage. Introduction to properties and applications of materials for medical technologies, such as orthopaedic implants, sensors, transducers, and materials for biomedical imaging and drug delivery. Selected case studies. Biomimetics as a design strategy for synthetic materials. Prereq: ENGR 200 and (ENGR 145 or EMSE 146).

EMSE 349. Materials for Energy and Sustainability. 3 Units.
Levels and categories of energy usage in the U.S. and the world. Availability of raw materials, including strategic materials; factors affecting global reserves and annual world production. Design strategies, and how the inclusion of environmental impacts as design criteria can alter materials selections. Resource demand (energy and water) of materials production, fabrication, and recycling. Roles of engineered materials in renewable or advanced energy technologies: photovoltaics, fuel cells, wind, batteries, capacitors, thermoelectrics. Energy harvesting. Role of magnetic materials in energy technology. Materials in energy-efficient lighting. Energy return on energy invested. Semester projects will enable students to explore related topics (e.g. geothermal; biomass; solar thermal; advances in energy-efficient manufacturing) in greater depth. Offered as EMSE 349 and EMSE 449. Prereq: ENGR 225 and (ENGR 145 or EMSE 146) and (PHYS 122 or PHYS 124) or requisites not met permission.

EMSE 365. Surface Engineering of Materials. 3 Units.
Introduction to surface engineering of materials, understood as a treatment that allows the surface to perform functions different from those performed by the bulk. This may include engineering the mechanical, chemical, electrical, magnetic, or optical properties of the surface and near-surface regions for specific applications. For a variety of technologically important classes of materials, the course reviews general concepts of surface engineering, the underlying physical and materials science principles, technical implementations, and typical applications. Recommended for graduate students and advanced undergraduate students. Offered as EMSE 365 and EMSE 465. Prereq: (EMSE 276 and ENGR 225) or Requisites Not Met permission.

EMSE 372. Structural Materials by Design. 4 Units.

EMSE 379. Design for Lifetime Performance. 3 Units.

EMSE 396. Special Project or Thesis. 1 - 18 Units.
Special research projects or undergraduate thesis in selected material areas.

EMSE 398. Senior Project in Materials I. 1 Unit.
Independent Research project. Projects selected from those suggested by faculty; usually entail original research. The EMSE 398 and 399 sequence form an approved SAGES capstone. Counts as SAGES Senior Capstone.

EMSE 399. Senior Project in Materials II. 2 Units.
Independent Research project. Projects selected from those suggested by faculty; usually entail original research. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Counts as SAGES Senior Capstone. Prereq: EMSE 398.
EMSE 400T. Graduate Teaching I. 0 Unit.
To provide teaching experience for all Ph.D.-bound graduate students. This will include preparing exams/quizzes, homework, leading recitation sessions, tutoring, providing laboratory assistance, and developing teaching aids that include both web-based and classroom materials. Graduate students will meet with supervising faculty member throughout the semester. Grading is pass/fail. Students must receive three passing grades and up to two assignments may be taken concurrently. Recommended preparation: Ph.D. student in Materials Science and Engineering.

EMSE 405. Dielectric and Electrical Properties of Materials. 3 Units.

EMSE 408. Welding Metallurgy. 3 Units.
Introduction to arc welding and metallurgy of welding. The course provides a broad overview of different industrial applications requiring welding, the variables controlling critical property requirements of the weld and a survey of the different types of arc welding processes. The course details the fundamental concepts that govern the different aspects of arc welding including the welding arc, weld pool solidification, precipitate formation and solid state phase transformations. Offered as EMSE 308 and EMSE 408.

EMSE 409. Deformation Processing. 3 Units.
Flow stress as a function of material and processing parameters; yielding criteria; stress states in elastic-plastic deformation; forming methods: forging, rolling, extrusion, drawing, stretch forming, composite forming. Recommended preparation: EMSE 303.

EMSE 413. Fundamentals of Materials Engineering and Science. 3 Units.
Provides a background in materials for graduate students with undergraduate majors in other branches of engineering and science: reviews basic bonding relations, structure, and defects in crystals. Lattice dynamics; thermodynamic relations in multi-component systems; microstructural control in metals and ceramics; mechanical and chemical properties of materials as affected by structure; control of properties by techniques involving structure property relations; basic electrical, magnetic and optical properties.

EMSE 417. Properties of Materials in Extreme Environments. 3 Units.
Fundamentals of degradation pathways of materials under extreme conditions; thermodynamic stability of microstructures, deformation mechanisms, and failure mechanisms. Extreme conditions that will typically be addressed include: elevated temperatures, high-strain rates (ballistic), environmental effects, nuclear radiation, and small scales. Examples will be drawn from recent events as appropriate.
EMSE 435. Strategic Metals and Materials for the 21st Century. 3 Units. This course seeks to create an understanding of the role of mineral-based materials in the modern economy focusing on how such knowledge can and should be used in making strategic choices in an engineering context. The history of the role of materials in emerging technologies from a historical perspective will be briefly explored. The current literature will be used to demonstrate the connectedness of materials availability and the development and sustainability of engineering advances with examples of applications exploiting structural, electronic, optical, magnetic, and energy conversion properties. Processing will be comprehensively reviewed from source through refinement through processing including property development through application of an illustrative set of engineering materials representing commodities, less common metals, and minor metals. The concept of strategic recycling, including design for recycling and waste stream management will be considered. Offered as EMSE 335 and EMSE 435. Prereq: Senior standing or graduate student.

EMSE 443. Materials for Electronics and Photonics. 3 Units. This course covers the basics of planar processing, which is the foundation of producing semiconductor chips and photonic devices, and the way these devices are incorporated into electronics and display technologies. Basic characteristics of semiconductors and optoelectronic devices; and how advances in these technologies arise from, and drive, advances in materials and device architecture. Offered as: EMSE 343 and EMSE 443. Prereq: (PHYS 122 or PHYS 124) and (EMSE 276 or EMSE 201).

EMSE 449. Materials for Energy and Sustainability. 3 Units. Levels and categories of energy usage in the U.S. and the world. Availability of raw materials, including strategic materials; factors affecting global reserves and annual world production. Design strategies, and how the inclusion of environmental impacts as design criteria can alter materials selections. Resource demand (energy and water) of materials production, fabrication, and recycling. Roles of engineered materials in renewable or advanced energy technologies: photovoltaics, fuel cells, wind, batteries, capacitors, thermoelectrics. Energy harvesting. Role of magnetic materials in energy technology. Materials in energy-efficient lighting. Energy return on energy invested. Semester projects will enable students to explore related topics (e.g. geothermal; biomass; solar thermal; advances in energy-efficient manufacturing) in greater depth. Offered as EMSE 349 and EMSE 449. Prereq: ENGR 225 and (ENGR 145 or EMSE 146) and (PHYS 122 or PHYS 124) or requisites not met permission.

EMSE 463. Magnetism and Magnetic Materials. 3 Units. This course covers the fundamentals of magnetism and application of modern magnetic materials especially for energy and data storage technologies. The course will focus on intrinsic and extrinsic magnetic properties, processing of magnetic materials to achieve important magnetic performance metrics, and the state-of-the-art magnetic materials used today. The topics related to intrinsic properties, include: magnetic dipole moments, magnetization, exchange coupling, magnetic anisotropy and magnetostriction. Topics related to extrinsic properties, include: magnetic hysteresis, frequency dependent magnetic response and magnetic losses. Technologically important permanent magnets (including rare earth containing alloys and magnetic oxides), soft magnets (including electrical steels, amorphous, ferrites, and nanocrystalline alloys), and thin film materials (including iron platinum) will be discussed in the context of their technological interest. Throughout the course, experimental techniques and data analysis will be discussed. The course is suitable for most graduate students and advanced undergraduates in engineering and science.

EMSE 465. Surface Engineering of Materials. 3 Units. Introduction to surface engineering of materials, understood as a treatment that allows the surface to perform functions different from those performed by the bulk. This may include engineering the mechanical, chemical, electrical, magnetic, or optical properties of the surface and near-surface regions for specific applications. For a variety of technologically important classes of materials, the course reviews general concepts of surface engineering, the underlying physical and materials science principles, technical implementations, and typical applications. Recommended for graduate students and advanced undergraduate students. Offered as EMSE 365 and EMSE 465.

EMSE 499. Materials Science and Engineering Colloquium. 0 - 1 Units. Invited speakers deliver lectures on topics of active research in materials science. Speakers include researchers at universities, government laboratories, and industry. Course is offered both of 1 credit and 0 credits. Attendance is required for both, and graded coursework in the form of a term paper is required when registering for 1 credit. Offered as EMSE 499 and EMSE 599.

EMSE 500T. Graduate Teaching II. 0 Unit. To provide teaching experience for all Ph.D.-bound graduate students. This will include preparing exams/quizzes/homework, leading recitation sessions, tutoring, providing laboratory assistance, and developing teaching aids that include both web-based and classroom materials. Graduate students will meet with supervising faculty member throughout the semester. Grading is pass/fail. Students must receive three passing grades and up to two assignments may be taken concurrently. Recommended preparation: Ph.D. student in Materials Science and Engineering.

EMSE 503. Structure of Materials. 3 Units. The structure of materials and physical properties are explored in terms of atomic bonding and the resulting crystallography. The course will cover basic crystal chemistry, basic crystallography (crystal symmetries, point groups, translation symmetries, space lattices, and crystal classes), basic characterization techniques and basic physical properties related to a materials structure.


EMSE 505. Phase Transformations, Kinetics, and Microstructure. 3 Units. Phase diagrams are used in materials science and engineering to understand the interrelationships of composition, microstructure, and processing conditions. The microstructure and phases constitute of metallic and nonmetallic systems alike are determined by the thermodynamic driving forces and reaction pathways. In this course, solution thermodynamics, the energetics of surfaces and interfaces, and both diffusional and diffusionless phase transformations are reviewed. The development of the laws of diffusion and its application for both melts and solids are covered. Phase equilibria and microstructure in multicomponent systems will also be discussed.
EMSE 509. Conventional Transmission Electron Microscopy. 3 Units.
Introduction to transmission electron microscopy-theoretical background and practical work. Lectures and laboratory experiments cover the technical construction and operation of transmission electron microscopes, specimen preparation, electron diffraction by crystals, electron diffraction techniques of TEM, conventional TEM imaging, and scanning TEM. Examples from various fields of materials research illustrate the application and significance of these techniques. Recommended preparation: Consent of instructor.

EMSE 512. Advanced Techniques of Transmission Electron Microscopy. 3 Units.
Theory and laboratory experiments to learn advanced techniques of transmission electron microscopy, including high-resolution transmission electron microscopy (HRTEM), convergent-beam electron diffraction (CBED), microanalysis using X-ray energy-dispersive spectroscopy (XEDS) and electron energy-loss spectroscopy (EELS), and electron-spectroscopic imaging (ESI) for elemental mapping. Recommended preparation: EMSE 509.

EMSE 515. Analytical Methods in Materials Science. 3 Units.
Microcharacterization techniques of materials science and engineering: SPM (scanning probe microscopy), SEM (scanning electron microscopy), FIB (focused ion beam) techniques, SIMS (secondary ion mass spectrometry), EPMA (electron probe microanalysis), XPS (X-ray photoelectron spectrometry), and AES (Auger electron spectrometry), ESCA (electron spectrometry for chemical analysis). The course includes theory, application examples, and laboratory demonstrations.

EMSE 599. Materials Science and Engineering Colloquium. 0 - 1 Units.
Invited speakers deliver lectures on topics of active research in materials science. Speakers include researchers at universities, government laboratories, and industry. Course is offered both of 1 credit and 0 credits. Attendance is required for both, and graded coursework in the form of a term paper is required when registering for 1 credit. Offered as EMSE 499 and EMSE 599.

EMSE 600T. Graduate Teaching III. 0 Unit.
To provide teaching experience for all Ph.D.-bound graduate students. This will include preparing exam/quizzes/homework, leading recitation sessions, tutoring, providing laboratory assistance, and developing teaching aids that include both web-based and classroom materials. Graduate students will meet with supervising faculty member throughout the semester. Grading is pass/fail. Students must receive three passing grades and up to two assignments may be taken concurrently. Recommended preparation: Ph.D. student in Materials Science and Engineering.

EMSE 601. Independent Study. 1 - 18 Units.

EMSE 649. Special Projects. 1 - 18 Units.

EMSE 651. Thesis M.S.. 1 - 18 Units.
Required for Master's degree. A research problem in metallurgy, ceramics, electronic materials, biomaterials or archeological and art historical materials, culminating in the writing of a thesis.

EMSE 701. Dissertation Ph.D.. 1 - 9 Units.
Required for Ph.D. degree. A research problem in metallurgy, ceramics, electronic materials, biomaterials or archeological and art historical materials, culminating in the writing of a thesis. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

DSCI 134. Introduction to Applied Data Science. 3 Units.
This course is an introduction to data science and analytics. In the first half of the course, students will develop a basic understanding of how to manipulate, analyze and visualize large data in a distributed computing environment, with an appreciation of open source development, security and privacy issues. In the second half of the course, students will gain experience in data manipulation and analysis using scripted programming languages such as Python.

DSCI 351. Exploratory Data Science. 3 Units.
In this course, we will learn data science and analysis approaches to identify statistically significant relationships and better model and predict the behavior of these systems. We will assemble and explore real-world datasets, perform clustering and pair plot analyses to investigate correlations, and logistic regression will be employed to develop associated predictive models. Results will be interpreted, visualized and discussed. We will introduce basic elements of statistical analysis using R Project open source software for exploratory data analysis and model development. R is an open-source software project with broad abilities to access machine-readable open-data resources, data cleaning and munging functions, and a rich selection of statistical packages, used for data analytics, model development and prediction. This will include an introduction to R data types, reading and writing data, looping, plotting and regular expressions, so that one can start performing variable transformations for linear fitting and developing structural equation models, while exploring for statistically significant relationships. Offered as DSCI 351, DSCI 351M and DSCI 451. Prereq: (ENGR 131 or EECS 132 or DSCI 134) and (STAT 312R or DSCI 351) and (DSCI 351 or STAT 312R or STAT 201R or SYBB 310 or PQHS/EPBI 431).

DSCI 352. Applied Data Science Research. 3 Units.
This is a project based data science research class, in which project teams identify a research project under the guidance of a domain expert professor. The research is structured as a data analysis project including the 6 steps of developing a reproducible data science project, including 1: Define the ADS question, 2: Identify, locate, and/or generate the data 3: Preprocess the data 4: Analyze the data 5: Create and interpret the results 6: Synthesize the results in the domain context 5: Creation of reproducible research, including code, datasets, documentation and reports. During the course special topic lectures will include ethics, privacy, openness, security, ethics. Value. Offered as DSCI 352 and DSCI 452. Prereq: (DSCI 133 or DSCI 134 or ENGR 131 or ECON 132 and (STAT 312R or STAT 201R or SYBB 310 or PQHS/EPBI 431 or OPRE 207) and (DSCI 351 or SYBB 311A and SYBB 311B and SYBB 311C and SYBB 311D) or SYBB 321 or MKMR 201).
**DSCI 353. Data Science: Statistical Learning, Modeling and Prediction. 3 Units.**

In this course, we will use an open data science tool chain to develop reproducible data analyses useful for inference, modeling and prediction of the behavior of complex systems. In addition to the standard data cleaning, assembly and exploratory data analysis steps essential to all data analyses, we will identify statistically significant relationships from datasets derived from population samples, and infer the reliability of these findings. We will use regression methods to model a number of both real-world and lab-based systems producing predictive models applicable in comparable populations. We will assemble and explore real-world datasets, use pair-wise plots to explore correlations, perform clustering, self-similarity, and logistic regression develop both fixed-effect and mixed-effect predictive models. We will introduce machine-learning approaches for classification and tree-based methods. Results will be interpreted, visualized and discussed. We will introduce the basic elements of data science and analytics using R Project open source software. R is an open-source software project with broad abilities to access machine-readable open-data resources, data cleaning and assembly functions, and a rich selection of statistical packages, used for data analytics, model development, prediction, inference and clustering. For students with little prior R experience, we’ll introduce resources to learn R data types, reading and writing data, looping, plotting and regular expressions. With this background, it becomes possible to start performing variable transformations for linear regression fitting and developing structural equation models, fixed-effects and mixed-effects models along with other statistical learning techniques, while exploring for statistically significant relationships. The class will be structured to have a balance of theory and practice. We’ll split class into Foundation and Practicum a) Foundation: lectures, presentations, discussion b) Practicum: coding, demonstrations and hands-on data science work. Offered as DSCI 353, DSCI 353M and DSCI 453.

**DSCI 453. Data Science: Statistical Learning, Modeling and Prediction. 3 Units.**

In this course, we will use an open data science tool chain to develop reproducible data analyses useful for inference, modeling and prediction of the behavior of complex systems. In addition to the standard data cleaning, assembly and exploratory data analysis steps essential to all data analyses, we will identify statistically significant relationships from datasets derived from population samples, and infer the reliability of these findings. We will use regression methods to model a number of both real-world and lab-based systems producing predictive models applicable in comparable populations. We will assemble and explore real-world datasets, use pair-wise plots to explore correlations, perform clustering, self-similarity, and logistic regression develop both fixed-effect and mixed-effect predictive models. We will introduce machine-learning approaches for classification and tree-based methods. Results will be interpreted, visualized and discussed. We will introduce the basic elements of data science and analytics using R Project open source software. R is an open-source software project with broad abilities to access machine-readable open-data resources, data cleaning and assembly functions, and a rich selection of statistical packages, used for data analytics, model development, prediction, inference and clustering. For students with little prior R experience, we’ll introduce resources to learn R data types, reading and writing data, looping, plotting and regular expressions. With this background, it becomes possible to start performing variable transformations for linear regression fitting and developing structural equation models, fixed-effects and mixed-effects models along with other statistical learning techniques, while exploring for statistically significant relationships. The class will be structured to have a balance of theory and practice. We’ll split class into Foundation and Practicum a) Foundation: lectures, presentations, discussion b) Practicum: coding, demonstrations and hands-on data science work. Offered as DSCI 353, DSCI 353M and DSCI 453.

**Faculty**

Frank Ernst, Dr. rer. nat. habil.  
(University of Göttingen)  
**Leonard Case Jr. Professor of Engineering**  

William A. "Bud" Baeslack III, PhD  
(Rensselaer Polytechnic Institute)  
**Provost and Executive Vice President**  
Welding, joining of materials, and titanium and aluminum metallurgy.

Jennifer W. Carter, PhD  
(The Ohio State University)  
**Assistant Professor**  
Processing-structure-property relationships of crystalline and amorphous materials; development and implementation of novel multi-scale material characterization methods for correlating unique local microstructural features with particular mechanical and environmental responses in a variety of material systems.
Mark R. DeGuire, PhD  
(Massachusetts Institute of Technology)  
*Associate Professor*  

Roger H. French, PhD  
(Massachusetts Institute of Technology)  
*Kyocera Professor of Ceramics*  
Optical materials science, including optical properties, electronic structure, and radiation durability of optical materials, polymers, ceramics and liquids using vacuum ultraviolet and optical spectroscopies and spectroscopic ellipsometry. Lifetime and degradation science of photovoltaic materials, components and systems including solar radiation durability and degradation mechanisms and rates. Quantum electrodynamics and van der Waals – London dispersion interactions applied to wetting, and long range interactions for manipulation of nanoscale objects such as carbon nanotubes and biomolecular materials.

Peter Lagerlof, PhD  
(Case Western Reserve University)  
*Associate Professor*  
Mechanical properties of ceramics and metals. Of particular interest is to understand how low temperature deformation twinning is related to plastic deformation by dislocation slip at elevated temperatures. Deformation twinning models for both basal and rhombohedral twinning in sapphire, which are properly related to dislocation slip at elevated temperatures, have been established. The basal twinning model has been confirmed experimentally using TEM techniques. Current research involves studies on how to generalize this twinning model to other materials systems; i.e., metals, intermetallic compounds and other ceramics.

John J. Lewandowski, PhD  
(Carnegie Mellon University)  
*Arthur P. Arminston Professor of Engineering; Director, The Advanced Manufacturing and Mechanical Reliability Center (AMMRC)*  
Mechanical behavior of materials; fracture and fatigue; micromechanisms of deformation and fracture; composite materials; bulk metallic glasses and composites; refractory metals; toughening of brittle materials; high-pressure deformation and fracture studies; hydrostatic extrusion; deformation processing.

David H. Matthiesen, PhD  
(Massachusetts Institute of Technology)  
*Associate Professor; Director, Wind Energy Research and Commercialization (WERC) Center*  
Materials for use in wind turbines; wind resource measurements onshore and offshore; materials interactions with ice; bulk crystal growth processing; process engineering in manufacturing; heat, mass, and momentum transport.

James D. McGuffin-Cawley, PhD  
(Case Western Reserve University)  
*Arthur S. Holden Professor of Engineering*  
Powder processing of ceramics; manufacturing and materials; additive manufacturing and rapid prototyping; aggregation phenomena; defects, diffusion, and solid state reactions; materials for optical devices.

Alp Sehirlioglu, PhD  
(University of Illinois at Urbana Champaign)  
*Warren E. Rupp Assistant Professor*  
Energy conversion materials including piezoelectrics and thermoelectrics, high temperature applications, bulk and thin film electro-ceramics, epitaxial oxide thin films.

Gerhard E. Welsch, PhD  
(Case Western Reserve University)  
*Professor*  
Metals and oxides; high temperature properties, mechanical and electrical properties. Materials for capacitive energy storage; metal sponges; high temperature materials, metal-cell composites. Synthesis of materials.

Matthew A. Willard, PhD  
(Carnegie Mellon University)  
*Associate Professor; Director, Case Metals Casting Laboratory*  
Magnetic materials, including their magnetic properties, microstructure evolution, phase formation, and processing conditions; critical materials and sustainability, especially reducing dependence on rare earths through novel alloy design; rapid solidification processing of materials, with an emphasis on nanostructured and amorphous alloys; soft magnetic materials for power conditioning, conversion, and generation technologies and permanent magnet materials for motor, generator, and actuator applications (especially in energy dense applications and in extreme environments); other magnetic related phenomena, including magnetic shape memory alloys, magnetocaloric effects, magnetic nanoparticles, and multiferoics.

Research Faculty  
Laura S. Bruckman, PhD  
(University of South Carolina)  
*Assistant Professor*  
Electronic materials, lifetime and degradation science, data science.

Adjunct Faculty  
Arnon Chait, PhD  
(The Ohio State University)  
*Adjunct Professor*  
ANALIZA, Inc.

George Fisher, PhD  
*(Newcastle University)*  
*Adjunct Professor*  
Luxfer Gas Cylinders, Riverside, CA

Jennie S. Hwang, PhD  
(Case Western Reserve University)  
*Adjunct Professor*  
H-Technologies Group, Cleveland, OH

Ina Martin, PhD  
*(Colorado State University)*  
*Adjunct Assistant Professor*
Terence Mitchell, PhD  
(University of Cambridge)  
*Adjunct Professor*  
Los Alamos National Laboratory, Los Alamos, NM  

Badri Narayanan, PhD  
(The Ohio State University)  
*Adjunct Assistant Professor*  
Lincoln Electric Co., Euclid, OH  

Rudolph Podgornik, PhD  
(University of Ljubljana)  
*Adjunct Professor*  

Gary Ruff, PhD  
(Case Western Reserve University)  
*Adjunct Professor*  
Ruff Associates, Rochester Hills, MI  

Ali Sayir, PhD  
(Case Western Reserve University)  
*Adjunct Professor*  
Air Force Office of Scientific Research  

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**Secondary Faculty**  
burda clemens, phd  
*Professor of Chemistry*  

liming dai, phd  
*kent hale smith professor*  

walter lambrecht, phd  
*Professor of Physics*  

mohan sankaran, phd  
*Professor in Chemical Engineering*  

nicole f. steinmetz, phd  
*Assistant Professor of Biomedical Engineering*  

russell wang, dds  
*Associate Professor of Dentistry*  

xiong (bill) yu, phd, pe  
*Assistant Professor of Civil Engineering*  

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**Department of Mechanical and Aerospace Engineering**  
479c Glennan Building (7222)  
http://engineering.case.edu/emae/  
Phone: 216.368.6045; Fax: 216.368.6445  
Robert X. Gao, Cady Staley Professor of Engineering and Department Chair  
robert.gao@case.edu  

The Department of Mechanical and Aerospace Engineering of the Case School of Engineering offers programs leading to bachelors, masters, and doctoral degrees. It administers the programs leading to the degrees of Bachelor of Science in Engineering with a major in aerospace engineering and Bachelor of Science in Engineering with a major in mechanical engineering. Both curricula are based on four-year programs of preparation for productive engineering careers or further academic training. The Bachelor of Science degree program in Mechanical Engineering and the Bachelor of Science degree program in Aerospace Engineering are accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).  

**Mission**  
The mission of the Mechanical and Aerospace Engineering Department is to educate and prepare students at both the undergraduate and graduate levels for leadership roles in the fields of Mechanical Engineering and Aerospace Engineering and to conduct research for the benefit of society.  

The undergraduate program emphasizes fundamental engineering science, analysis and experiments to insure that graduates will be strong contributors in their work environment, be prepared for advanced study at top graduate schools and be proficient lifelong learners. The graduate programs emphasize advanced methods of analysis, mathematical modeling, computational and experimental techniques applied to a variety of mechanical and aerospace engineering specialties including, applied mechanics, dynamic systems, robotics, biomechanics, fluid mechanics, heat transfer, propulsion and combustion. Leadership skills are developed by infusing the program with current engineering practice, design, and professionalism (including engineering ethics and the role of engineering in society) led by concerned educators and researchers.  

The academic and research activities of the department center on the roles of mechanics, thermodynamics, heat and mass transfer, robotics, mechatronics, data analytics, sustainability in manufacturing, and engineering design in a wide variety of applications such as aeronautics, astronautics, biomechanics and orthopedic engineering, biomimetics and biologically-inspired robotics, energy, environment, machinery dynamics, mechanics of advanced materials, nanotechnology and tribology. Many of these activities involve strong collaborations with the Departments of Biology, Electrical Engineering and Computer Science, Materials Science and Engineering, and Orthopaedics of the School of Medicine.  

The significant constituencies of the Mechanical and Aerospace Engineering Department are the faculty, the students, the alumni and the external advisory boards. The educational program objectives are established and reviewed continuously, based on the feedback from the various constituencies as well as archival information about the program graduates. The faculty engages in continuing discussions of the academic programs in the regularly scheduled faculty meetings throughout the academic year. Periodic surveys of alumni provide data regarding the preparedness and success of the graduates as well as guidance in program development. Archival data include the placement information for graduating seniors, which provides direct information regarding the success of the graduates in finding employment or being admitted to graduate programs.  

**Mastery of Fundamentals**  
- A strong background in the fundamentals of chemistry, physics and mathematics.  
- Methods of mechanical engineering analysis, both numerical and mathematical, applied to mechanics, dynamic systems and control, thermodynamics, fluid mechanics and heat transfer.  
- Methods of modern experimental engineering analysis and data acquisition.  

**Creativity**  
- Ability to identify, model, and solve mechanical and aerospace engineering design problems.
• Ability to design experiments to resolve mechanical and aerospace engineering issues.
• Ability to perform an individual senior project that demonstrates original research and/or design content.

Societal Awareness
• Issues of environmental impact, efficient use of energy and resources, benefits of recycling.
• An awareness of the multidisciplinary nature of mechanical and aerospace engineering.
• Impact of economic, product liability and other legal issues on mechanical and aerospace engineering manufacturing and design.

Leadership Skills
• An ability to work in teams.
• Ethical considerations in engineering decisions.
• Proficiency in oral and written communication.
• Professionalism
• Students are encouraged to develop as professionals through participation in the student chapters of the American Society of Mechanical Engineers (ASME) and the American Institute of Aeronautics and Astronautics (AIAA).
• Students are encouraged to augment their classroom experiences with the cooperative education program and the strong graduate research program of the department.
• Students are encouraged to take the Fundamentals of Engineering Examination as the first step in the process of becoming a registered professional engineer.
• The bachelor’s candidate must complete an independent design project with an oral and written final report.
• The master’s candidate must demonstrate independent research resulting in a thesis or project suitable for publication and/or presentation in peer reviewed journals and/or conferences.
• The doctoral candidate must complete a rigorous independent thesis containing original research results appropriate for publication in archival journals and presentation at leading technical conferences.

Aerospace Engineering
Aerospace engineering has grown dramatically with the rapid development of the computer in experiments, design and numerical analysis. The wealth of scientific information developed as a result of aerospace activity forms the foundation for the aerospace engineering major.

Scientific knowledge is being developed each day for programs to develop reusable launch vehicles (RLV), the International Space Station (ISS), High Speed Transport (HST), Human Exploration and Development of Space (HEDS) and micro-electro-mechanical sensors and control systems for advanced flight. New methods of analysis and design for structural, fluid, and thermodynamic applications are required to meet these challenges.

The aerospace engineering major has been developed to address the needs of those students seeking career opportunities in the highly specialized and advancing aerospace industries.

Mechanical Engineering
Civilization, as we know it today, depends on the intelligent and humane use of our energy resources and machines. The mechanical engineer’s function is to apply science and technology to the design, analysis, development, manufacture, and use of machines that convert and transmit energy, and to apply energy to the completion of useful operations. The top ten choices of the millennium committee of the National Academy of Engineering, asked to select the 20 top engineering accomplishments of the 20th century, was abundant with mechanical engineering accomplishments, electrification (large scale power generation and distribution), automobiles, air travel (development of aircraft and propulsion), mechanized agriculture, and refrigeration and air conditioning.

Research
Aerospace Technology and Space Exploration
Flow in turbomachinery, molecular dynamics simulation of rarefied gas flow, two phase flow, supersonic combustion and propulsion, thermoacoustic refrigeration, in-situ resource utilization from space. Gravitational effects on transport phenomena, fluids and thermal processes in advance life support systems for long duration space travel, interfacial processes, g-jitter effects on microgravity flows, two phase flow in zero and reduced gravity.

Combustion and Fire Engineering
Hydrogen ignition and safety, catalytic combustion, flame spread, fire research and protection, combustion in micro- and partial gravity.

Data Analytics
Multi-domain signal decomposition and analysis, wavelet transform and other transformation methods, data fusion, stochastic modeling and statistical methods for defect detection, root cause diagnosis, and remaining service life prognosis, multi-scale analysis.

Dynamics of Rotating Machinery
Forced and instability vibration of rotor/bearing/seal systems, nonlinear rotor dynamics, torsional rotor vibration, rotor dynamic characteristics of bearings and seals (computational and experimental approach), control of rotor system dynamics, rub-impact studies on bearings and compressor/turbine blading systems. Advanced rotating machinery monitoring and diagnostics.

Engineering Design
Optimization and computer-aided design, feasibility studies of kinematic mechanisms, kinematics of rolling element-bearing geometries, mechanical control systems, experimental stress analysis, failure analysis, development of biologically inspired methodologies.

Heat Transfer
Analysis of heat transfer in complex systems such as biological organisms, multi-functional materials and building enclosures.

Sustainable and Additive Manufacturing
Modeling, characterization and manufacturing of next-generation lithium ion batteries for electric vehicles and perovskite solar cells for low-cost solar power generation, multiphysics electrochemistry modeling, atomic layer deposition, scalable nano-manufacturing, life cycle assessment of lithium ion batteries on environmental sustainability, agile manufacturing work cells based on coordinated, multiple robots, additive manufacturing, in-process sensing and control.
Materials
Development of novel experimental techniques to investigate material response at elevated temperatures and high rates of deformation. Constitutive modeling of damage evolution, shear localization and failure of advanced engineering materials. Fabrication of mechanical properties of composite materials; creep, rupture, and fatigue properties of engineering materials at elevated temperatures.

Multiphase Flow
Application of non-intrusive laser based diagnostic techniques and ultrasound techniques including pulsed ultrasound Doppler velocimetry to study solid-liquid, solid-gas, liquid-gas and solid-liquid-gas, multiphase flows encountered in slurry transport and bio-fluid mechanics.

Nanotechnology
Research related to various nanotechnology applications with particular emphasis on energy conversion, generation and storage in nanostructured materials including the synthesis of polymer-based nanocomposites. Current research projects include investigation of nanocomposites for thermo-electric devices, molecular simulation of thermal transport across interfacial regions, and biomimetic research on protein-based shark gel.

Musculoskeletal Mechanics and Materials
Design, modeling, and failure analysis of orthopaedic prostheses and material selection; mechanical properties of, and transport processes in, bone and soft tissue; tribology of native and tissue engineered cartilage; nondestructive mechanical evaluation of tissue engineered cartilage.

Robotics
Biologically inspired and biologically based design and control of legged robots. Dynamics, control and simulation of animals and robots. Distributed intelligence, swarm robotics, social robots, wearable telesensors, and tangible game interface.

Sensing and Metrology
Signal transduction mechanisms, design, modeling, functional characterization, and performance evaluation of mechanical, thermal, optical, and magnetic-field sensors, multi-physics sensing, and precision instrumentation.

Tribology and Seals
Time-resolved friction on nano- and microsecond time scale with applications to high speed machining and mechanics of armor penetration. Study of gas lubricated foil bearing systems with application to oil-free turbomachinery. Evaluation of advanced seal concepts and configurations for high temperature applications in gas turbine engines.

Turbomachinery
Vibration characteristics of seals and bearings and measurement of chaotic motion. Rub impact studies of blade tip/casing interactions, particle-blade/casing interactions in centrifugal pumps.

Undergraduate Programs
Bachelor of Science in Engineering

Program Educational Objectives: Aerospace Engineering
- Graduates will enter and successfully engage in careers in Aerospace Engineering and other professions appropriate to their background, interests, and skills.

Program Educational Objectives: Mechanical Engineering
- Graduates will enter and successfully engage in careers in Mechanical Engineering and other professions appropriate to their background, interests, and skills.
- Graduates will engage in continued learning through post-baccalaureate education and/or professional development in engineering or other professional fields.
- Graduates will develop as leaders in their chosen professions.

Student Outcomes
As preparation for achieving the above educational objectives, the B.S. degree programs in Aerospace Engineering and Mechanical Engineering are designed so that students attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multidisciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The Bachelor of Science in Mechanical Engineering and the Bachelor of Science in Aerospace Engineering degree programs are accredited by the Engineering Accreditation Commission of ABET, www.abet.org

Bachelor of Science in Engineering
Major in Aerospace Engineering
In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

<table>
<thead>
<tr>
<th>Major Courses</th>
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<tbody>
<tr>
<td>EMAE 160</td>
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<tr>
<td>EMAE 181</td>
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<td>EMAE 250</td>
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<td>EMAE 285</td>
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</table>
EECS 304  Control Engineering I with Laboratory 3

ECIV 310  Strength of Materials 3

EMAE 325  Fluid and Thermal Engineering II 4

EMAE 350  Mechanical Engineering Analysis 3

EMAE 355  Design of Fluid and Thermal Elements 3

EMAE 356  Aerospace Design 3

EMAE 359  Aero/Gas Dynamics 3

EMAE 376  Aerostructures 3

EMAE 382  Propulsion 3

EMAE 383  Flight Mechanics 3

EMAE 384  Orbital Dynamics 3

EMAE 398  Senior Project 3

One Technical Elective 3

For the Engineering Core natural science and math requirement

PHYS 221  Introduction to Modern Physics 3

Total Units 56

Technical Electives by Program

• All 200-, 300-, and 400-level courses from the following areas: EMAE all, EMAE cross-listed, EBME all, EBME cross-listed, ECIV all, EECS all, EECS cross-listed, & EMAC all

• All 300- and 400-level courses in ECHE and EMSE areas

• All 300-level MATH and STAT courses with the concurrence of the advisor

NOTE: We are not accepting EMSE 201 as a technical elective.

Bachelor of Science in Engineering

Suggested Program of Study: Major in Aerospace Engineering

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

First Year

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<thead>
<tr>
<th>Units</th>
<th>Fall</th>
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<tbody>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
<td>4</td>
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<tr>
<td>Calculus for Science and Engineering I (MATH 121)**d</td>
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</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121)**d</td>
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<tr>
<td>FSCC 100 SAGES First Seminar*</td>
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<tr>
<td>PHED 101 Physical Education Activities*</td>
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<tr>
<td>Calculus for Science and Engineering II (MATH 122)**d</td>
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<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)**d</td>
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<tr>
<td>Chemistry of Materials (ENGR 145)**d</td>
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<tr>
<td>Elementary Computer Programming (ENGR 131)</td>
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<tr>
<td>SAGES University Seminar*</td>
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<td>PHED 102 Physical Education Activities</td>
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Second Year

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<tr>
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<tr>
<td>Mechanical Manufacturing (EMAE 160)d</td>
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<tr>
<td>Dynamics (EMAE 181)d</td>
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<tr>
<td>Statics and Strength of Materials (ENGR 200)**d</td>
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<td>Calculus for Science and Engineering III (MATH 223)**d</td>
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<td>Computers in Mechanical Engineering (EMAE 250)d</td>
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<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)**d</td>
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<tr>
<td>Introduction to Modern Physics (PHYS 221)**d</td>
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<tr>
<td>Elementary Differential Equations (MATH 224)**d</td>
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<tr>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**d</td>
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<tr>
<td>SAGES University Seminar*</td>
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Third Year

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<tr>
<td>Humanities or Social Science Elective**</td>
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<tr>
<td>Fluid and Thermal Engineering II (EMAE 325)</td>
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<tr>
<td>Mechanical Engineering Measurements Laboratory (EMAE 285)d</td>
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<tr>
<td>Strength of Materials (ECIV 310)d</td>
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<tr>
<td>Mechanical Engineering Analysis (EMAE 350)</td>
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<td>Humanities or Social Science Elective**</td>
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<tr>
<td>Aero/Gas Dynamics (EMAE 359)</td>
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<tr>
<td>Aerostructures (EMAE 376)</td>
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<td>Technical Elective</td>
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<td>Control Engineering I with Laboratory (EECS 304)</td>
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<td>Year Total:</td>
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Fourth Year

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<th>Units</th>
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<tbody>
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<td>Humanities or Social Science Elective**</td>
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<td></td>
</tr>
<tr>
<td>Design of Fluid and Thermal Elements (EMAE 355)d</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Flight Mechanics (EMAE 383)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Orbital Dynamics (EMAE 384)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Humanities or Social Science Elective**</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Aerospace Design (EMAE 356)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Propulsion (EMAE 382)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Senior Project (EMAE 398)d</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGL 398) &amp; Professional Communication for Engineers (ENGR 398)**</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 128

Hours required for graduation: 129

* University general education requirement
** Engineering general education requirements

d May be taken fall or spring semester.

Bachelor of Science in Engineering
Major in Mechanical Engineering

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

Major Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAE 160</td>
<td>Mechanical Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 181</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 250</td>
<td>Computers in Mechanical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 260</td>
<td>Design and Manufacturing I</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 285</td>
<td>Mechanical Engineering Measurements Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>EECS 304</td>
<td>Control Engineering I with Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>ECIV 310</td>
<td>Strength of Materials</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 325</td>
<td>Fluid and Thermal Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>EMAE 350</td>
<td>Mechanical Engineering Analysis</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 355</td>
<td>Design of Fluid and Thermal Elements</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 360</td>
<td>Design and Manufacturing II</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 370</td>
<td>Design of Mechanical Elements</td>
<td>3</td>
</tr>
<tr>
<td>EMAE 398</td>
<td>Senior Project</td>
<td>3</td>
</tr>
<tr>
<td>Four Technical Electives</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

Technical Electives by Program

- All 200-, 300-, and 400-level courses from the following areas: EMAE all, EMAE cross-listed, EBME all, EBME cross-listed, ECIV all, EECS all, EMAE cross-listed, & EMAC all
- All 300- and 400-level courses in ECHE and EMSE areas
- All 300-level MATH and STAT courses with the concurrence of the advisor

NOTE: We are not accepting EMSE 201 as a technical elective.

Science Electives for Mechanical Engineering Majors

The Student Information System is currently set up to accept PHYS 221 Introduction to Modern Physics or STAT 312 Basic Statistics for Engineering and Science as a science elective. Other courses for individual students can be selected with the approval of the student’s advisor and the chair using an Academic Advisement Requirement Form (https://case.edu/ugstudies/media/caseedu/undergraduate-studies/forms-applications/advisement-report-correction.pdf).

Bachelor of Science in Engineering
Suggested Program of Study: Major in Mechanical Engineering

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

**First Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSSC 100 SAGES First Seminar</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHED 101 Physical Education Activities*</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary Computer Programming (ENGR 131)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHED 102 Physical Education Activities*</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>16</td>
<td>18</td>
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</tr>
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</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Manufacturing (EMAE 160)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamics (EMAE 181)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statics and Strength of Materials (ENGR 200)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers in Mechanical Engineering (EMAE 250)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science Elective**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities or Social Science Elective**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid and Thermal Engineering II (EMAE 325)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Engineering Measurements Laboratory (EMAE 285)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength of Materials (ECIV 310)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Engineering Analysis (EMAE 350)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humanities or Social Science Elective**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Elective**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design and Manufacturing I (EMAE 260)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Engineering I with Laboratory (EECS 304)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design of Mechanical Elements (EMAE 370)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>17</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

**Fourth Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities or Social Science Elective**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design of Fluid and Thermal Elements (EMAE 355)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Design and Manufacturing II (EMAE 360) 3
Open Elective d 3
Technical Elective d 3
Humanities or Social Science Elective ** d 3
Technical Elective d 3
Senior Project (EMAE 398) d 3
Professional Communication for Engineers (ENGL 398) 3
& Professional Communication for Engineers (ENGR 398) **
Year Total: 15 15

Total Units in Sequence: 128

Hours required for graduation: 129

* University general education requirement
** Engineering general education requirement
d May be taken fall or spring semester.

Double Major Mechanical and Aerospace Engineering

The department also offers a double major in Mechanical and Aerospace Engineering. The course selection details are provided in the course listing section.

Suggested Program of Study: Double Major in Mechanical and Aerospace Engineering

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111) **</td>
<td>4</td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121) ** d</td>
<td>4</td>
</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121) ** d</td>
<td>4</td>
</tr>
<tr>
<td>FSCC 100 SAGES First Seminar d</td>
<td>4</td>
</tr>
<tr>
<td>PHED (2 half semester courses)</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122) ** d</td>
<td>4</td>
</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122) ** d</td>
<td>4</td>
</tr>
<tr>
<td>Elementary Computer Programming (ENGR 131) ** d</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry of Materials (ENGR 145) ** d</td>
<td>4</td>
</tr>
<tr>
<td>SAGES University Seminar d</td>
<td>3</td>
</tr>
<tr>
<td>PHED (2 half semester courses)</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>16 18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>Mechanical Manufacturing (EMAE 160) d</td>
<td>3</td>
</tr>
<tr>
<td>Dynamics (EMAE 181) d</td>
<td>3</td>
</tr>
<tr>
<td>Statics and Strength of Materials (ENGR 200) ** d</td>
<td>3</td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223) ** d</td>
<td>3</td>
</tr>
<tr>
<td>Computers in Mechanical Engineering (EMAE 250) d</td>
<td>3</td>
</tr>
</tbody>
</table>

Introduction to Circuits and Instrumentation (ENGR 210) ** d 4
Introduction to Modern Physics (PHYS 221) ** d 3
Elementary Differential Equations (MATH 224) ** d 3
Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225) ** d 4
SAGES University Seminar d 3
Year Total: 15 17

Third Year

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
</tr>
<tr>
<td>Humanities or Social Science Elective ** d</td>
</tr>
<tr>
<td>Fluid and Thermal Engineering II (EMAE 325)</td>
</tr>
<tr>
<td>Mechanical Engineering Measurements Laboratory (EMAE 285) d</td>
</tr>
<tr>
<td>Strength of Materials (ECIV 310) d</td>
</tr>
<tr>
<td>Mechanical Engineering Analysis (EMAE 350)</td>
</tr>
<tr>
<td>Design and Manufacturing I (EMAE 260) d</td>
</tr>
<tr>
<td>Aero/Gas Dynamics (EMAE 359)</td>
</tr>
<tr>
<td>Design of Mechanical Elements (EMAE 370)</td>
</tr>
<tr>
<td>Aerostructures (EMAE 376)</td>
</tr>
<tr>
<td>Control Engineering I with Laboratory (EECS 304)</td>
</tr>
<tr>
<td>Year Total:</td>
</tr>
</tbody>
</table>

Fourth Year

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
</tr>
<tr>
<td>Humanities or Social Science Elective ** d</td>
</tr>
<tr>
<td>Humanities or Social Science Elective ** d</td>
</tr>
<tr>
<td>Flight Mechanics (EMAE 383)</td>
</tr>
<tr>
<td>Orbital Dynamics (EMAE 384)</td>
</tr>
<tr>
<td>Design of Fluid and Thermal Elements (EMAE 355) d</td>
</tr>
<tr>
<td>Design and Manufacturing II (EMAE 360)</td>
</tr>
<tr>
<td>Humanities or Social Science Elective ** d</td>
</tr>
<tr>
<td>Aerospace Design (EMAE 356)</td>
</tr>
<tr>
<td>Propulsion (EMAE 382)</td>
</tr>
<tr>
<td>Senior Project (EMAE 398) ** d</td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGR 398)</td>
</tr>
<tr>
<td>&amp; Professional Communication for Engineers (ENGL 398) **</td>
</tr>
<tr>
<td>Year Total:</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 131

Hours required for graduation: 132

* University general education requirement
** Engineering general education requirement
d May be taken fall or spring semester.

Cooperative Education (http://engineering.case.edu/coop)

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer).
Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

**BS/MS Program**

The combined bachelors/masters program allows a student to double count 9 credit hours of graduate course work towards the Bachelor of Science degree in any one of the department's two degree programs. By completing the remaining graduate credit hours and a thesis, a student may earn a Master of Science degree in mechanical or aerospace engineering. This may take 5 years or a little longer. Application to this program is initiated in the spring of the junior year with the department's graduate student programs office. A minimum grade point of 3.2 is required for consideration for this accelerated program. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

**BS/MS Program of Study Details**

The current regulations for the MS degree by the School of Graduate Studies (http://www.case.edu/provost/gradstudies) require a minimum of 18 credit hours of coursework at the 400-level (or higher). Please note that any 400-level course taken prior to admission to the BS/MS Program cannot typically be counted as part of the MS degree. However Senior Project (EMAE398) may be included in the double counted credit hours toward the MS Thesis if appropriate.

The School of Graduate Studies allows a 300-level course to be included in the Program of Study of regular MS degrees. One legitimate rationale for a 300-level course in a BS/MS Program would be for a student to take this course as background in a subject that is not a normal part of their own discipline; such a selected 300-level course must be supported by the student's Research Advisor. However, 300-level courses in the student's major field are not normally to be considered as part of the Program of Study.

Follow the links below to learn more about the components of the BS/MS Program.

- BS/MS Application Process (https://engineering.case.edu/emae/bs-ms/application-process)
- BS/MS Thesis Project (https://engineering.case.edu/emae/bs-ms/thesis)
- BS/MS Financial Aid (https://engineering.case.edu/emae/bs-ms/financial-aid)
- BS/MS Graduation (https://engineering.case.edu/emae/bs-ms/graduation)

If you have additional questions, please contact either:

- Professor Kiju Lee kiju.lee@case.edu
- Student Affairs Coordinator Carla Wilson cxw75@case.edu

**Master of Engineering and Management Program**

Another option is the 5 year TiME Program taught in conjunction with the Weatherhead School of Management in which a student completes a BS in Aerospace or Mechanical Engineering and earns a Master of Engineering and Management.

### Minor in Mechanical Design and Manufacturing

A minor in Mechanical Design and Manufacturing is offered to students in other departments with an interest in design and manufacturing. The minor consists of an approved set of five EMAE courses.

<table>
<thead>
<tr>
<th>Required Courses:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EMAE 160</td>
<td>Mechanical Manufacturing</td>
</tr>
<tr>
<td>EMAE 260</td>
<td>Design and Manufacturing I</td>
</tr>
<tr>
<td>EMAE 370</td>
<td>Design of Mechanical Elements</td>
</tr>
<tr>
<td></td>
<td>Two of the following:</td>
</tr>
<tr>
<td>EMAE 290</td>
<td>Computer-Aided Manufacturing</td>
</tr>
<tr>
<td>EMAE 372</td>
<td>Structural Materials by Design</td>
</tr>
<tr>
<td>EMAE 390</td>
<td>Advanced Manufacturing Technology</td>
</tr>
<tr>
<td></td>
<td>EMAE 397 Independent Laboratory Research</td>
</tr>
<tr>
<td></td>
<td>(can be used as an elective in this minor sequence under the following conditions)</td>
</tr>
</tbody>
</table>

1). Student writes a one-page proposal clearly explaining how the project involves mechanical design and/or manufacturing at an advanced undergraduate level.
2). The proposal is approved by both the student's major advisor, and the EMAE advisor for the mechanical design and manufacturing minor.

**Total Units** 15

### Graduate Programs

**Master of Science in Aerospace Engineering or Mechanical Engineering**

**Research- or Project-Oriented**

For a research-oriented MS, each candidate must complete a minimum of 27 hours of graduate-level credits, including at least 18 hours of graduate-level courses and 9 credit hours of MS thesis research.

For the project-oriented option, students must complete 27 credit hours distributed in either of three ways: 21, 24, or 27 credit hours (7, 8 or 9 courses) of approved graduate course work and 6, or 3 credit hours of project replacing the MS thesis.

**Course Oriented**

Each MS candidate must complete 27 hours of graduate-level credits. The candidate has to pass a comprehensive examination upon completion of the course work.

**List of Required Graduate Courses**

Depending on the area of interest, students should select courses from this list with the approval of their advisor.

**I. Biomechanics**

- EMAE 415 Intro to Bio-Mechanics (required course for the specified area)
· EMAE/EBME 402 Muscles, Biomechanics and Control of Movements (required course for the specified area)
· EMAE 456 BioMEMS (required course for the specified area)
· EMAE 466 Mechanics of Biological Fluids *
· EMAE 414 Nano-biomechanics *
· EMAE 480 Fatigue of Materials *

II. Dynamics, Control and Manufacturing
· EMAE 481 Advanced Dynamics I (required course for the specified area)
· EMAE 487 Mechanical Vibrations (required course for the specified area)
· EMAE 560 Sustainable Manufacturing (required course for the specified area)
· EECS 475 Applied Control (required course for the specified area)
· EMAE 488 Advanced Robotics *
· EMAE 540 Advanced Dynamics II *

III. Fluids and Thermal Sciences
· EMAE 453 Advanced Fluid Dynamics I (required course for the specified area)
· EMAE 459 Advanced Heat Transfer (required course for the specified area)
· EMAE 455 Advanced Thermodynamics (required course for the specified area)
· EMAE 454 Advanced Fluid Dynamics II *
· EMAE 457 Combustion *
· EMAE 471 Computational Fluid Dynamics *

IV. Solid Mechanics
· ECIV 411 Elasticity Theory and Applications (required course for the specified area)
· ECIV 420 Finite Element Analysis (required course for the specified area)
· EMAE 401 Mechanics of Continuous Media (required course for the specified area)
· EMAE 501 Constitutive Modeling of Materials (required course for the specified area)
· EMAE 689 Battery Dynamics and Modeling *
· EMAE XXX Computational Methods in Solid Mechanics *

V. Online and other Courses
· EMAE 450 Advanced Engineering Analysis *
· EMAE 460 Fluid Machinery *
· EMAE 461 Fire Dynamics *
· EMAE 494 Energy Systems *
· EMAE 544 Turbulence *
· EMAE 585 Advanced Topics in Solid Mechanics *

* Electives

In addition, a BS/MS program and a 5-year TiME program (BS/ Master of Engineering Management) are also offered for our undergraduate students as indicated in the preceding section.

A Master of Science in Mechanical Engineering is also available exclusively online. Visit http://online-engineering.case.edu/mechanical/ for more details.

Master of Engineering Program
The Department of Mechanical and Aerospace Engineering participates in the practice-oriented Master of Engineering Program offered by the Case School of Engineering. In this program, students complete a core program consisting of five courses, and select a four-course sequence in an area of interest.

The Master of Engineering degree is also available exclusively online. Visit http://online-engineering.case.edu/masters for more details.

Master of Science in Mechanical Engineering with Specialization

Fire Science and Engineering
The Case School of Engineering at Case Western Reserve University offers an MS graduate program in Fire Science and Engineering. Students will choose either a Master of Science in Mechanical Engineering or a Master of Science in Macromolecular Science and Engineering, both with a concentration in fire science. Case Western Reserve offers a unique intersection of expertise in macromolecular and combustion science and mechanical and chemical engineering, making us singularly suited to cover all aspects of fire protection, safety and flammability.

Through a 27-credit-hour curriculum, students explore and learn how to apply the fundamental principles of fire behavior and dynamics, protection and suppression systems, polymeric materials structure, properties and selection and more. The program is designed to be completed in a single 12 month year, but can be spread out over multiple years.

The Fire Science and Engineering program at Case Western Reserve covers all aspects of combustion and fire suppression. After graduating from this degree program, students will be ready to apply their thorough understanding of:

· The chemistry of fire and materials
· Flammability logistics
· Fire dynamics and fire behavior
· Fire risk assessment
· Fire protection engineering
· Combustion
· Fire and safety-related codes
· Human behavior and life safety analysis
· Structural fire protection
· Passive fire protection systems
· Polymer engineering

Elective tracks:
· Mechanical track to focus on mechanical engineering and combustion related to fire protection and suppression
· Materials track to focus on polymer chemistry and materials, and the chemistry of flammability and fire suppression

Fire Science and Engineering // Degree and Curriculum

Degree Options
The Fire Science and Engineering master’s degree program comprises 27 credit hours, which may be all coursework or include an MS thesis (9 credit hours) or a project (3 to 6 credit hours). Students can choose to receive a Master of Science in Mechanical Engineering with a concentration in Fire Science and Engineering; or a Master of Science in Macromolecular Science and Engineering with a concentration in Fire Science and Engineering.
in Macromolecular Science and Engineering with a concentration in Fire Science and Engineering.

All students will take six core fire protection engineering courses. Other courses can be chosen from the elective track for mechanical engineering or macromolecular science and engineering. The mechanical track follows a traditional mechanical engineering/combustion approach to fire protection and suppression, but with specialization classes in polymers. The materials track focuses on polymer chemistry and materials, and the chemistry of flammability and fire suppression. The degree can be finished in one year or in multiple years. Students have the option of completing a thesis or research project at their employers’ laboratories with Case Western Reserve faculty members as co-advisors.

Academic Calendar

This fire protection engineering degree is offered over three semesters: 12 credits in the fall semester; 12 credits in the spring semester; and 3 credits in the summer. See the university’s academic calendar (http://www.case.edu/registrar/calendar.html).

Fire Science and Engineering Degree Core Course Requirements (18 Credits):

EMAE/EMAC* 461 (ITN) Chemistry of Fire Safe Polymers and Composites (3 credits)
This course introduces the most important concepts in polymer flammability. Topics include: the mechanism, kinetics and products of polymer flammability; methods for evaluating polymer flammability and the ramifications of different test results; modes of action and use of flame retardant agents.

EMAE/EMAC* 462 Flammability Laboratory (3 credits)
This course introduces details of polymer flammability testing, and provides hands-on experimental experience in methods including cone calorimetry, LOI, TGA and smoke generation. Students will evaluate commercial products, with and without added flame retardants.

EMAE/EMAC* 463 Fire Dynamics (3 credits)
This course introduces the burning behavior of materials and the underlying thermo-fluid dynamics. Topics include: pre-mixed flames, diffusion flames, steady burning of condensed fuels, ignition, extinction, flame spread over surfaces, fire plum, compartment fire, flashover, and smoke movement.

EMAE/EMAC* 464 Fire Protection Engineering (3 credits)
This course introduces essentials of fire protection in industry and houses. Topics include: fire in history, fire tetrahedron, fire behavior, fire characteristics of combustibles, smoke toxicity and heat hazards, building design, prevention and risk mitigation, fire detection systems, mechanisms of fire extinguishment, fire extinguishing agents and systems, fire modeling

EMAE 457 Combustion (3 credits)
Chemical kinetics and thermodynamics; governing conservation equations for chemically reacting flows; laminar premixed and diffusion flames; turbulent flames; ignition; extinction and flame stabilization; detonation; liquid droplet and solid particle combustion; flame spread; combustion-generated air pollution

EMAC 404 Polymer Engineering (3 credits)
Engineering and technology of polymeric materials. Topics include additives, blends and composites, natural polymers and fibers, thermoplastics, elastomers, and thermosets, polymer degradation and stability, polymers in the environment, polymer rheology and polymer processing, and polymers for advanced technologies (membrane science, biomedical engineering, applications in electronics, photonics polymers). A lecture portion is integrated with a laboratory component, in which experiments will be conducted that is directly connected to the class work.

Choose one of the following two elective tracks:

**Elective Track I: Mechanical Engineering (9 credits)**

EMAE 453 Advanced Fluid Dynamics I (3 credits)
Derivation and discussion of the general equations for conservation of mass, momentum, and energy using tensors. Several exact solutions of the incompressible Newtonian viscous equations. Kinematics and dynamics of inviscid, incompressible flow including free streamline theory developed using vector, complex variable, and numerical techniques.

EMAE 459 Advanced Heat Transfer (3 credits)
Analysis of engineering heat transfer from first principles including conduction, convection, radiation, and combined heat and mass transfer. Examples of significance and role of analytic solutions, approximate methods (including integral methods) and numerical methods in the solution of heat transfer problems. Prerequisite: EMAE 453

EMAE 558 Conduction and Radiation (3 credits)
Fundamental laws, initial and boundary conditions, basic equations for isotropic and anisotropic media, related physical problems, steady and transient temperature distributions in solid structures. Analytical, graphical, numerical, and experimental methods for constant and variable material properties.

**Elective Track II: Macromolecular Science and Engineering (9 credits)**

EMAC 401 (ITN)* Polymer Synthesis (3 credits)
Synthesis and organic chemistry of macromolecules: This course introduces the most important polymerization reactions, focusing on their reaction mechanisms and kinetic aspects. Topics include free radical and ionic chain polymerization, condensation (step-growth) polymerization, ring-opening, insertion and controlled addition polymerization. A lecture portion is integrated with a laboratory component, in which experiments are directly connected to the class work.

EMAC 402 (ITN)* Polymer Physical Chemistry (3 credits)
Physical chemistry of polymers in solution: Topics include polymer statistics (i.e., microstructure, chain configuration, and chain dimensions), thermodynamics and transport properties of polymers in solution, methods for molecular weight determination, physical chemistry of water-soluble polymers, and characterization of polymer microstructure (IR and NMR). A lecture portion is integrated with a laboratory component, in which experiments are directly connected to the class work.

EMAC 403 (ITN)* Polymer Physics (3 credits)
Physics of polymers in the bulk amorphous and crystalline states: Topics include structural and morphological analysis using X-ray diffraction, electron microscopy and atomic force microscopy, characterization of thermal transitions, viscoelastic behavior and rubber elasticity, and dynamic mechanical analysis. A lecture portion is integrated with a laboratory component, in which experiments are directly connected to the class work.

**EMAC 405 Polymer Structure and Characterization** (3 credits)
Application of microscopy techniques to the analysis of the microstructure of polymeric materials. Specifically, atomic force microscopy, transmission and scanning electron microscopy, and optical microscopy. Practical aspects of these techniques will be applied to a variety of polymer systems.

For additional information, please contact:

David Schiraldi, Chair of the Department of Macromolecular Science and Engineering

James S. Tien, Leonard Case Jr. Professor of Engineering in Mechanical and Aerospace Engineering

**Learn more about the faculty who teach these courses.** [http://engineering.case.edu/fire/faculty](http://engineering.case.edu/fire/faculty)

**How to Apply**
Application to the Fire Science and Engineering program is handled through the university’s School of Graduate Studies. Students will need to know whether they wish to apply for the MS in Mechanical Engineering or the MS in Macromolecular Science and Engineering.

Students interested in applying to the Fire Science and Engineering program should already have a bachelor’s degree in Chemistry, Chemical Engineering, Mechanical Engineering or Materials Science & Engineering and have taken the GRE. Additional application requirements include a statement of objectives, academic transcripts, and three letters of recommendation. International students will also need to take the Test of English as a Foreign Language (TOEFL). Read more about the university’s full application procedure requirements here [http://www.case.edu/gradstudies/prospective-students/admissions-information](http://www.case.edu/gradstudies/prospective-students/admissions-information).

When you are ready to apply, electronic applications can be submitted here [https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantConnectLogin.asp?id=case-gr](https://app.applyyourself.com/AYApplicantLogin/fl_ApplicantConnectLogin.asp?id=case-gr).

**Doctor of Philosophy Program**

Students wishing to pursue the doctoral degree in mechanical and aerospace engineering must successfully pass the doctoral qualifying examination consisting of both written and oral components. Qualifying exams are offered on applied mechanics, dynamics and design or fluid and thermal engineering sciences. Students can choose to take it in the fall or spring semesters. The minimum course requirements for the PhD degree are as follows:

**Depth Courses**
All programs of study must include 6 graduate level mechanical courses in mechanical engineering or aerospace engineering. Usually these courses follow a logical development of a branch of mechanics, dynamics and design or fluid and thermal engineering science determined in conjunction with the student’s dissertation advisor to meet the objectives of the dissertation research topic.

**Breadth and Basic Science Courses**
A minimum of six graduate courses are required to fulfill the breadth and basic science courses. The basic science requirement is satisfied by taking two courses in the area of science and mathematics. Four additional courses are needed to provide the breadth outside the student’s area of research.

**Dissertation Research**
All doctoral programs must include a minimum of 18 credit hours of thesis research, EMAE 701 Dissertation Ph.D.

**List of Required Ph.D. Courses**

I. **Biomechanics**
- EMAE 415 Intro to Bio-Mechanics (required course for the specified area)
- EMAE/EBME 402 Muscles, Biomechanics and Control of Movements (required course for the specified area)
- EMAE 456 BioMEMS (required course for the specified area)
- EMAE 466 Mechanics of Biological Fluids *
- EMAE 414 Nano-biomechanics *
- EMAE 480 Fatigue of Materials *

II. **Dynamics, Control and Manufacturing**
- EMAE 481 Advanced Dynamics I (required course for the specified area)
- EMAE 487 Mechanical Vibrations (required course for the specified area)
- EECS 475 Applied Control (required course for the specified area)
- EMAE 560 Sustainable Manufacturing (required course for the specified area)
- EMAE 488 Advanced Robotics *
- EMAE 540 Advanced Dynamics II *

III. **Fluids and Thermal Sciences**
- EMAE 453 Advanced Fluid Dynamics I (required course for the specified area)
- EMAE 459 Advanced Heat Transfer (required course for the specified area)
- EMAE 455 Advanced Thermodynamics (required course for the specified area)
- EMAE 454 Advanced Fluid Dynamics II *
- EMAE 457 Combustion *
- EMAE 471 Computational Fluid Dynamics *

IV. **Solid Mechanics**
- ECIV 411 Elasticity Theory and Applications (required course for the specified area)
- ECIV 420 Finite Element Analysis (required course for the specified area)
- EMAE 401 Mechanics of Continuous Media (required course for the specified area)
- EMAE 501 Constitutive Modeling of Materials (required course for the specified area)
- EMAE 689 Battery Dynamics and Modeling *
- EMAE XXX Computational Methods in Solid Mechanics *

V. **Online and other Courses**
- EMAE 450 Advanced Engineering Analysis *
- EMAE 460 Fluid Machinery *
- EMAE 461 Fire Dynamics *
- EMAE 494 Energy Systems *
- EMAE 544 Turbulence *
- EMAE 585 Advanced Topics in Solid Mechanics *

* Electives

**Residence and Teaching Requirements**

All doctoral programs must meet the residency requirements of the School of Graduate Studies and the teaching requirements of the Case School of Engineering.

**Facilities**

The education and research philosophy of the Department of Mechanical and Aerospace Engineering for both the undergraduate and graduate programs is based on a balanced operation of analytical, experimental, and computational activities. All three of these tools are used in a fundamental approach to the professional activities of research, development, and design. Among the major assets of the department are the experimental facilities maintained and available for the faculty, students, and staff.

The introductory undergraduate courses are taught through the Robert M. Ward ’41 Laboratory, the Bingham Student Workshop, the Reinberger Product and Process Development Laboratory, and the Reinberger Design Studio. The Ward Laboratory is modular in concept and available to the student at regularly scheduled class periods to conduct a variety of prepared experimental assignments. The lab is equipped with a variety of instruments ranging from classic analog devices to modern digital computer devices for the collection of data and the control of processes. Advanced facilities are available for more specialized experimental tasks in the various laboratories dedicated to each specific discipline. Most of these laboratories also house the research activities of the department, so students are exposed to the latest technology in their prospective professional practice. Finally, every undergraduate and graduate degree program involves a requirement, i.e., Project, Thesis or Dissertation, in which the student is exposed to a variety of facilities of the department.

The following is a listing of the major laboratory facilities used for the advanced courses and research of the department.

**Biorobotics Laboratory Facilities**

The Biorobotics Laboratory (http://biorobots.cwru.edu/) consists of approximately 1080 square feet of laboratory and 460 square feet of office space. The lab includes two CNC machines for fabrication of smaller robot components. The lab’s relationship with CAISR (Center for Automation and Intelligent Systems Research) provides access to a fully equipped machine shop where larger components are fabricated. The laboratory hardware features several biologically inspired hexapod robots including two cockroach-like robots, Robot III and Robot IV. Both are based on the Blaberus cockroach and have 24 actuated revolute joints. They are 17 times larger than the insect (30 inches long). Robot IV is actuated with pneumatic artificial muscles. A compressed air facility has been installed to operate the robots. In addition, the lab contains structural dynamic testing equipment (sensors, DAQ boards, shakers) and an automated treadmill (5 feet by 6 feet) for developing walking robots. The Biorobotics Laboratory contains 20 PCs, and a dedicated LAN connected to the campus. Algor Finite Element Analysis software, Mechanical Desktop, and Pro/Engineer are installed for mechanical design and structural analysis. Also, the lab has developed dynamic simulation software for analyzing walking animals and designing walking robots.

**Distributed Intelligence and Robotics Laboratory**

The Distributed Intelligence and Robotics Laboratory (DIRL) is a new laboratory in the Department of Mechanical and Aerospace Engineering that facilitates research activities on robotics and mechatronics. The primary research focuses on distributed intelligence, multi-agent systems, biologically-inspired robotics and medical applications. The laboratory is currently being constructed to house self-sufficient facilities and equipment for designing, testing and preliminary manufacturing. The DIRL also conduct theoretical research related to design methodology and control algorithms based on information theory, complexity analysis and group theory.

**Mechanics of Materials Experimental Facility**

The major instructional as well as research facility for experimental methods in mechanics of materials is the Daniel K. Wright Jr. Laboratory. Presently, the facility houses a single-stage gas-gun along with tension/compression split Hopkinson bar and torsional Kolsky bar apparatus for carrying out fundamental studies in dynamic deformation and failure of advanced material systems. Hewlett Packard and Tektronix high speed, wide bandwidth digitizing oscilloscopes along with strain-gage conditioners and amplifiers are available for data recording and processing. The facility houses state-of-the-art laser interferometry equipment for making spatial and temporal measurements of deformation. High speed Hg-Cd-Te detector arrays are available for making time resolved multi-point non-contact temperature measurements.

A Schenck Pegasus digital servo-controlled hydraulic testing system with a 20Kip Universal testing load frame equipped with hydraulic grips and instrumentation is available for quasi-static mechanical testing under load or displacement control. A newly developed moiré microscope is available for studying large-scale inelastic deformation processes on micron size scales. CCD camera along with the appropriate hardware/software for image-acquisition, processing and analyzing of full field experimental data from optical interferometers such as moiré microscope, photo-elasticity, and other laser based spatial interferometers are available.

**Multiphase Flow and Laser Diagnostics Laboratory**

A laser diagnostics laboratory is directed toward investigation of complex two-phase flow fields involved in energy-related areas, bio-fluid mechanics of cardiovascular systems, slurry flow in pumps and thermoacoustic power and refrigeration systems. The laboratory is equipped with state-of-the-art Particle Image Velocimetry (PIV) equipment, Pulsed Ultrasound Doppler Velocimeter, Ultrasound concentration measurement instrumentation and modern data acquisition and analysis equipment including PCs. The laboratory houses a clear centrifugal slurry flow pump loop and heart pump loop. Current research projects include investigation of flow through microchip devices, CSF flow in ventricles, investigation of solid-slurry flow in centrifugal pumps using ultrasound technique and PIV, thermo-acoustic refrigeration for space application.

**Rotating Machinery Dynamics and Tribology Laboratory**

This laboratory focuses on rotating machinery monitoring and diagnostic methods relating chaos content of dynamic non-linearity and model-based observers’ statistical measures to wear and impending failure modes. A double-spool-shaft rotor dynamics test rig provides independent control over spin speed and frequency of an adjustable...
magnitude circular rotor vibration orbit for bearing and seal rotor-dynamic characterizations.

Simultaneous radial and axial time-varying loads on any type of bearing can be applied on a second test rig. Real time control of rotor-mass unbalance at two locations on the rotor while it is spinning up to 10,000 rpm, simultaneous with rotor rubbing and shaft crack propagation, can be tested on a third rig. Self-excited instability rotor vibrations can be investigated on a fourth test rig.

Musculoskeletal Mechanics and Materials Laboratories
These laboratories are a collaborative effort between the Mechanical and Aerospace Engineering Department of the Case School of Engineering and the Department of Orthopaedics of the School of Medicine that has been ongoing for more than 40 years. Research activities have ranged from basic studies of mechanics of skeletal tissues and skeletal structures, experimental investigation of prosthetic joints and implants, measurement of musculoskeletal motion and forces, and theoretical modeling of mechanics of musculoskeletal systems. Many studies are collaborative, combining the forces of engineering, biology, biochemistry, and surgery. The Biomechanics Test labs include Instron mechanical test machines with simultaneous axial and torsional loading capabilities, a non-contacting video extensometer for evaluation of biological materials and engineering polymers used in joint replacements, acoustic emission hardware and software, and specialized test apparatus for analysis of joint kinematics. The Bio-imaging Laboratory includes microscopes and three-dimensional imaging equipment for evaluating tissue microstructure and workstations for three-dimensional visualization, measurement and finite element modeling. An Orthopaedic Implant Retrieval Analysis lab has resources for characterization and analysis of hard tissues and engineering polymers, as well as resources to maintain a growing collection of retrieved total hip and total knee replacements that are available for the study of implant design. The Soft Tissue Biomechanics lab includes several standard and special test machines. Instrumentation and a Histology facilities support the activities within the Musculoskeletal Mechanics and Materials Laboratories.

nanoEngineering Laboratory
The nanoEngineering Laboratory focuses on research related to various nanotechnology applications with particular emphasis on energy conversion, generation and storage in nanostructured and bio-inspired materials. Synthesis of polymer-based nanocomposites, nanofluids and individual nanostructures is accomplished with tools available in the laboratory. Furthermore, the laboratory houses various pieces of equipment for thermal and electrical characterization of these materials. Research projects include investigation of nanocomposites for thermoelectric devices, molecular simulation of thermal transport across interfacial regions, characterization of nanomaterials for thermal management (of electronics and buildings) as well as thermal insulation applications, and biomimetic research on a protein-based shark gel.

Other Experimental Facilities
The department facilities also include several specialized laboratories.

Engineering Services Fabrication Center offers complete support to assist projects from design inception to completion of fabrication. Knowledgeable staff is available to assist Faculty, Staff, Students, Researchers, and personnel associated with Case Western Reserve University.

The Bingham Student Workshop is a 2380 sq. ft. facility complete with machining, welding, metal fabrication, and woodworking equipment. This facility is available for the Case undergrads in Mechanical Engineering. Before gaining access to the shop all ME students are required to take the EMAE 160, Mechanical Manufacturing course. This course gives the student a foundation in basic machining, welding, sheet metal fabrication, and safety. Manual drafting, design, and computer-aided drafting is also included in the course. After completion the student can use the shop for any Mechanical Engineering courses requiring prototypes. The BSW, is also, used for senior projects and student organizations, such as, the SAE Baja and Formula and the Design Build and Fly.

The Harry A. Metcalf Laboratory in Glennan Hall Room 458, which was made possible through the generous gift of Sylvia Lissa to honor her late husband and Mechanical Engineering graduate, Class of 1903, has recently been renovated and updated. The restructuring of the computational lab and adjacent experimental lab takes advantage of the Case School of Engineering’s Virtual Desktop Infrastructure built on Citrix XenDesktop via gigabit networking. This high-speed networking provides access to software packages including SolidWorks, PTC Creo, MasterCam, Abaqus, MatLab, Microsoft Office, Mathematica, LabView, and many others. The lab is set up to allow the students to use their laptops or ones provided in the lab by the Department for course and project work. As a result of using the Virtual Desktop infrastructure, engineering students will also be able to access the engineering software listed above from anywhere on any device. Students’ home drives are automatically mapped as well when using the virtual applications so that they have access to their files at all times on any device.

The Reinberger Design Studio includes a total of 33 Wyse terminals for Undergraduate Student design use. The Studio is tied directly to the campus network allowing information to be shared with the HAMCL and other network resources. The Studio is used for the instruction of the SolidWorks 2005 CAD software, MasterCam 9.0 CAM software, Solidworks CAD/CAM/FEA software, and Algor 16.1 FEA software. The RDS also offers a 3D Systems SLA 250 and a Dimension machine for generating SLA models from CAD models.

The Reinberger Product and Process Development Laboratory is 1600 square feet of laboratory and office space dedicated to computer-aided engineering activities. The computer numerical control (CNC) laboratory includes both two industrial sized machine tools with additional space for lecture and group project activities. The CNC machine tools located in the laboratory are; a HAAS VF3 4 axis-machining center, a HAAS 2 axis lathe. A Mitutoyo coordinate measuring machine (CMM) located in its own laboratory space completes the facilities. The CMM enables students to inspect their manufactured components to a very degree of precision. The laboratory is used to support both undergraduate and graduate manufacturing courses (EMAE 390, EMAE 490).

High Performance Computing
For high performance computing the department uses the CWRU high performance computing cluster (HPCC). The HPCC consists of 112 compute nodes with Intel Pentium 4 Xeon EM64T processors. All nodes are interconnected with Gigabit Ethernet for MPI message passing and all nodes are interconnected by a separate Ethernet for the purpose of out-of-band cluster management. The MAE Department also has a direct access to all the Ohio Supercomputing Center and all NSF supercomputing centers, primarily to the Pittsburgh Supercomputing Center. Computing-intensive research projects can obtain an account on those supercomputers through their advisors. Research projects carried on in cooperation with the NASA Glenn Research Center can have access to NASA computing facilities. Sophisticated, extensive, and updated

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general and graphics software are available for applications in research and classroom assignments.

**Faculty**

Robert X. Gao, PhD  
(technical university of Berlin, Germany)  
*Cady Staley Professor of Engineering and Department Chair*  
Signal transduction, mechatronic systems, acoustics, wavelet transform, stochastic modeling, sensors and sensor networks

Alexis R. Abramson, PhD  
(University of California at Berkeley)  
*Milton and Tamar Maltz Professor of Engineering and Director, Great Lakes Energy Institute*  
Macro/micro/nanoscale heat transfer and energy transport

Ozan Akkus, PhD  
(Case Western Reserve University)  
*Leonard Case Jr. Professor of Engineering*  
Nano biomechanics, biomedical devices, biomaterials, fracture mechanics

Richard J. Bachmann, PhD  
(Case Western Reserve University)  
*Assistant Professor*  
Biologically inspired robotics

Paul Barnhart, PhD, PE  
(Case Western Reserve University)  
*Professor*  
Aerospace engineering, aerospace design

Sunniva Collins, PhD, FASM  
(Case Western Reserve University)  
*Associate Professor, Director of Undergraduate Studies and Online Programs*  
Design for manufacturing, steel metallurgy, heat treatment, surface engineering, fatigue analysis, fatigue of metals, welding, material analytical methods

Malcolm N. Cooke, PhD  
(Case Western Reserve University)  
*Associate Professor*  
Advanced manufacturing systems, computer integrated manufacturing

Kathryn Daltorio, PhD  
(Case Western Reserve University)  
*Assistant Professor*  
Biologically-inspired robotics, control, learning, kinetics, and kinematics for robots design

Umut A. Gurkan, PhD  
(Purdue University)  
*Assistant Professor*  
Micro-and nano-scale technologies, biomaterials, cell mechanics, and microfluidics

Yasuhiro Kamotani, PhD  
(Case Western Reserve University)  
*Professor*  
Experimental fluid dynamics, heat transfer, microgravity fluid mechanics

Kiju Lee, PhD  
(John Hopkins University)  
*Nord Distinguished Assistant Professor*  
Robotics, distributed system design and control, modular robotics, multi-body dynamical systems

Bo Li, PhD  
(California Institute of Technology)  
*Assistant Professor*  
Solid and computational mechanics, meshfree methods, failure processes in solids, biomechanics, thermal-fluid structure interaction and high performance computing

Ya-Ting T. Liao, PhD  
(Case Western Reserve University)  
*Assistant Professor*  
Fire dynamics, computational fluid dynamics, thermal fluids

Joseph M. Prahl, PhD, PE  
(Howard University)  
*Professor*  
Fluid dynamics, heat transfer, tribology

Vikas Prakash, PhD  
(Brown University)  
*Professor*  
Experimental and computational solid mechanics, dynamic deformation and failure, time resolved high-speed friction, nanomechanics, energy storage

Roger D. Quinn, PhD  
(Virginia Polytechnic Institute & State University)  
*Arthur P. Armington Professor of Engineering*  
Biologically inspired robotics, agile manufacturing systems, structural dynamics, vibration and control

Clare M. Rimnac, PhD  
(Lehigh University)  
*Wilbert J. Austin Professor of Engineering*  
Biomechanics; fatigue and fracture mechanics

Fumiaki Takahashi, PhD  
(Keio University)  
*Professor*  
Combustion, fire science and engineering

James S. Tien, PhD  
(Princeton University)  
*Leonard Case Jr. Professor of Engineering*  
Combustion; propulsion, and fire research

Chris Yingchun Yuan, PhD  
(University of California at Berkeley)  
*Associate Professor*  
Sustainable manufacturing, lithium ion battery, modeling and characterization for energy storage
Emeritus Faculty

Maurice L. Adams, PhD  
(University of Pittsburgh)  
Professor Emeritus  
Dynamics of rotating machinery, nonlinear dynamics, vibration, tribology, turbomachinery

Dwight T. Davy, PhD, PE  
(University of Iowa)  
Professor Emeritus  
Musculo-skeletal biomechanics; applied mechanics

Isaac Greber, PhD  
(Massachusetts Institute of Technology)  
Professor Emeritus  
Fluid dynamics; molecular dynamics and kinetic theory; biological fluid mechanics; acoustics

Jaikrishnan R. Kadambi, PhD  
(University of Pittsburgh)  
Professor Emeritus  
Experimental fluid mechanics, laser diagnostics, bio-fluid mechanics, turbomachinery

Joseph M. Mansour, PhD  
(Rensselaer Polytechnic Institute)  
Professor Emeritus  
Biomechanics and applied mechanics

Thomas P. Kicher, PhD  
(Case Institute of Technology)  
Arthur P. Armington Professor Emeritus of Engineering  
Elastic stability; plates and shells; composite materials; dynamics; design; failure analysis

Simon Ostrach, PhD, PE  
(Brown University)  
Wilbert J. Austin Distinguished Professor Emeritus of Engineering  
Fluid mechanics; heat transfer; micro-gravity phenomena; materials processing; physicochemical hydrodynamics

Eli Reshotko, PhD  
(California Institute of Technology)  
Kent H. Smith Emeritus Professor of Engineering  
Fluid Dynamics; heat transfer, propulsion; power generation

Mohammad Kassemi, PhD  
(University of Akron)  
Research Professor, National Center for Space Exploration Research  
Computational fluid mechanics

Vedha Nayagam, PhD  
(University of Kentucky)  
Research Associate Professor, National Center for Space Exploration Research  
Low gravity combustion and fluid physics

Associated Faculty

Michael Adams, PhD  
(Case Western Reserve University)  
Adjunct Instructor; Cleveland State University  
Dynamics, vibration

J. Iwan D. Alexander, PhD  
(Washington State University)  
Adjunct Professor; University of Alabama at Birmingham  
Wake dynamics, wind turbine aeroacoustics

Ali Ameri, PhD  
(The Ohio State University)  
Adjunct Assistant Professor  
Computational Fluid Dynamics

Christos C. Chamis, PhD  
(Case Western Reserve University)  
Adjunct Professor; NASA Glenn Research Center  
Structural analysis; composite materials; probabilistic structural analysis; testing methods

James Drake, BSE  
(Case Western Reserve University)  
Adjunct Instructor  
Manufacturing processes

Christopher Hernandez, PhD  
(Stanford University)  
Adjunct Associate Professor; Cornell University  
Musculoskeletal biomechanics, solid mechanics and medical device design

Meng-Seng Liou, PhD  
(University of Michigan)  
Adjunct Professor; NASA Glenn Research Center  
Computational fluid mechanics; aerodynamics; multi-objective optimization

Kenneth Loparo, PhD  
(Case Western Reserve University)  
Professor of Electrical Engineering and Computer Science  
Control; robotics; stability of dynamical systems; vibrations

David Matthiesen, PhD  
(Massachusetts Institute of Technology)  
Associate Professor of Materials Science Engineering  
Microgravity crystal growth

Research Faculty

R. Balasubramaniam, PhD  
(Case Western Reserve University)  
Research Associate Professor, National Center for Space Exploration Research  
Microgravity fluid mechanics

Uday Hegde, PhD  
(Georgia Institute of Technology)  
Research Associate Professor, National Center for Space Exploration Research  
Combustion, turbulence and acoustics
Wyatt S. Newman, PhD  
(Massachusetts Institute of Technology)  
Professor of Electrical Engineering and Computer Science  
Mechatronics; high-speed robot design; force and vision-bases machine control; artificial reflexes for autonomous machines; rapid prototyping; agile manufacturing

Mario Garcia Sanz, PhD  
(University of Navarra)  
Professor of Electrical Engineering and Computer Science  
Systems and control, spacecraft controls, automated manufacturing

Ravi Vaidyanathan, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor; Imperial College  
Robotics and control

Chih-Jen (Jackie) Sung, PhD  
(Princeton University)  
Adjunct Professor; University of Connecticut  
Combustion, propulsion, laser diagnostics

Xiong Yu, PhD, PE  
(Purdue University)  
Assistant Professor  
Geotechnical engineering, non-destructive testing, intelligent infrastructures

Courses

EMAE C100. Co-Op Seminar I for Mechanical Engineering. 1 Unit.  
Professional development activities for students returning from cooperative education assignments. Recommended preparation: COOP 1.

EMAE C200. Co-Op Seminar II for Mechanical Engineering. 2 Units.  
Professional development activities for students returning from cooperative education assignments. Recommended preparation: COOP 2 and EMAE C100.

EMAE 160. Mechanical Manufacturing. 3 Units.  
The course is taught in two sections/Graphics and Manufacturing. Manufacturing To introduce manufacturing processes and materials and their relationships to mechanical design engineering. Course includes hands-on machining and metal fabrication lab. Also, each lab creates a virtual field trip of a manufacturing facility to be shared with the class. Graphics Development of mechanical engineering drawings in orthographic, sectional, and pictorial views using manual drafting and computer-aided drafting (CAD software), dimensioning, tolerancing geometric dimensioning and tolerancing and assembly drawings will also be covered. All students are paired up to give a Manufacturing Design Presentation demonstrating the course material. The course has two (75) minute lectures and one (110) minute Machining Lab per week.

EMAE 181. Dynamics. 3 Units.  
Elements of classical dynamics: particle kinematics and dynamics, including concepts of force, mass, acceleration, work, energy, impulse, momentum. Kinetics of systems of particles and of rigid bodies, including concepts of mass center, momentum, mass moment of inertia, dynamic equilibrium. Elementary vibrations. Recommended preparation: MATH 122 and PHYS 121 and ENGR 200.

EMAE 250. Computers in Mechanical Engineering. 3 Units.  

EMAE 251. Thermodynamics. 3 Units.  
Thermodynamic concepts and definitions, properties of pure substances, work and heat, first and second laws, entropy, power and refrigeration cycles, thermodynamic relations, mixtures and solutions, chemical reactions, phase and chemical equilibrium. Prereq: CHEM 111, PHYS 121 and MATH 122.

EMAE 252. Fluid Mechanics. 3 Units.  
Fluid properties, hydrostatics, fluid dynamics and kinematics, control volume analysis, differential analysis, dimensional analysis and similitude, viscous internal flows, external flows and boundary layers, lift and drag. Prereq: EMAE 251 and MATH 223.

EMAE 260. Design and Manufacturing I. 3 Units.  
This is the second course of a 4-course sequence focusing on "Engineering Design and Manufacturing." This course develops students' competence and self-confidence as design engineers by exposing the students to design as a creative process and its relationship with modern manufacturing practices. The outcomes of the course focus on the student's ability to apply their knowledge of mathematics, science, and engineering to design a system, component, or process that meets desired needs within realistic, multi-dimensional constraints, such as: economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. Additionally, students will be given the opportunity to identify, formulate, and solve engineering problems, while applying professional and ethical practices. Professional communication skills are emphasized and expected during all stages of the design process. The course has five main areas of emphasis: design as a creative process, decision-based design methodologies, project management, engineering economics, and design for manufacture (CAD/CAM/CAE) using industrial software tools. The course exposes the student to the integration of engineering design, manufacturing, and management disciplines and includes activities to consider and understand the complex processes associated with controlling and managing product data through all stages of the product life-cycle (PLM). Topics include: engineering ethics, design as a creative process, design methodologies, project management, engineering economics, product life-cycle management (PLM), CAD/CAE/CAM, and the role of digital manufacturing within the design process. Design/Rapid Prototyping Studio activities are an integral part of the course, and enable the students to be part of a design and build team working on various project-based tasks. Prereq: EMAE 160.

EMAE 285. Mechanical Engineering Measurements Laboratory. 4 Units.  
Techniques and devices used for experimental work in mechanical and aerospace engineering. Lecture topics include elementary statistics, linear regression, propagation of uncertainty, digital data acquisition, characteristics of common measurement systems, background for measurement laboratories, and elements of report writing. Hands-on laboratory experiences may include measurements in solid mechanics, dynamics, and fluid and thermal sciences, which are summarized in group reports. At least one report will focus on design of a measurement. Recommended preparation: EMAE 181, ENGR 225 and ECIV 310.
EMAE 290. Computer-Aided Manufacturing. 3 Units.
An advanced design and manufacturing engineering course covering a wide range of topics associated with the ‘design for manufacturability’ concept. Students will be introduced to a number of advanced solid modeling assignments (CAD), rapid prototyping (RP), and computer-aided manufacturing (CAM). In addition students will be introduced to computer numerical control (CNC) manual part-programming for CNC milling and turning machine tools. All students will be given a design project requiring all detail and assembly drawings for a fully engineered design. The course has two (50) minute lectures and one (110) minute CAD/CAM Lab per week. Prereq: EMAE 160.

EMAE 325. Fluid and Thermal Engineering II. 4 Units.
The continuation of the development of the fundamental fluid and thermal engineering principles introduced in ENGR 225, Introduction to Fluid and Thermal Engineering. Applications to heat engines and refrigeration, chemical equilibrium, mass transport across semi-permeable membranes, mixtures and air conditioning, developing external and internal flows, boundary layer theory, hydrodynamic lubrication, the role of diffusion and convection in heat and mass transfer, radiative heat transfer and heat exchangers. Recommended preparation: ENGR 225.

EMAE 350. Mechanical Engineering Analysis. 3 Units.

EMAE 352. Thermodynamics in Energy Processes. 3 Units.
Thermodynamic properties of liquids, vapors and real gases, thermodynamic relations, non-reactive mixtures, psychometrics, combustion, thermodynamic cycles, compressible flow. Prereq: ENGR 225.

EMAE 353. Heat Transfer. 3 Units.
Steady-state and transient conduction, principles of convection, empirical relations for forced convection, natural convection, boiling and condensation, radiation heat transfer, heat exchangers, mass transfer. Prereq: EMAE 251 and EMAE 252.

EMAE 355. Design of Fluid and Thermal Elements. 3 Units.

EMAE 356. Aerospace Design. 3 Units.
Interactive and interdisciplinary activities in areas of fluid mechanics, heat transfer, solid mechanics, thermodynamics, and systems analysis approach in design of aerospace vehicles. Projects involve developing (or improving) design of aerospace vehicles of current interest (e.g., hypersonic aircraft) starting from mission requirements to researching developments in relevant areas and using them to obtain conceptual design. Senior standing required.

EMAE 359. Aero/Gas Dynamics. 3 Units.

EMAE 360. Design and Manufacturing II. 3 Units.
This is the third course of a 4-course sequence focusing on “Engineering Design and Manufacturing,” and is the senior capstone design course focused on a semester-long design/build/evaluate project. The course draws on a student’s past and present academic and industrial experiences and exposes them to the design and manufacture of a product or device that solves an open-ended ”real world” problem with multidimensional constraints. The course is structured and time-tabled within the Case School of Engineering (CSE) to give the EMAE 360 students the opportunity to team with students from other CSE departments (e.g., BME and EECS) to form multidisciplinary design teams to work on the solution to a common problem. The outcomes of the course continue to focus on the student’s ability to function on multidisciplinary teams while applying their knowledge of mathematics, science and engineering to design a system, component, or process that meets desired needs within realistic, multidimensional constraints, such as: economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. Professional communication skills are emphasized and expected during all stages of the design process and will include formal and informal oral presentations, periodic peer-focused design reviews, and a development through its various evolutionary stages to completion. Counts as SAGES Senior Capstone. Prereq: EMAE 160 and EMAE 260.

EMAE 363. Mechanical Engineering Modern Analysis Methods. 3 Units.
This is a required mechanical engineering course to develop an in-depth fundamental understanding of current analysis software tools, as well as to develop an ability to perform practical analyses using current software tools to analyze assigned industrial case studies for the following topical areas: (1) mechanism synthesis, (2) finite element analyses for stress and deflection, (3) machinery vibration, and (4) computational fluid dynamics. It is comprised of three lectures and one software application laboratory period per week. Prereq: ENGR 225, EMAE 181, EMAE 250, and ECIV 310.

EMAE 370. Design of Mechanical Elements. 3 Units.

EMAE 371. Computational Fluid Dynamics. 3 Units.

EMAE 372. Structural Materials by Design. 4 Units.
EMAE 376. Aerostructures. 3 Units.

EMAE 377. Biorobotics Team Research. 3 Units.
Many exciting research opportunities cross disciplinary lines. To participate in such projects, researchers must operate in multi-disciplinary teams. The Biorobotics Team Research course offers a unique capstone opportunity for undergraduate students to utilize skills they developed during their undergraduate experience while acquiring new teaming skills. A group of eight students form a research team under the direction of two faculty leaders. Team members are chosen from appropriate majors through interviews with the faculty. They will research a biological mechanism or principle and develop a robotic device that captures the actions of that mechanism. Although each student will cooperate on the team, they each have a specific role, and must develop a final paper that describes the research generated on their aspect of the project. Students meet for one class period per week and two 2-hour lab periods. Initially students brainstorm ideas and identify the project to be pursued. They then acquire biological data and generate robotic designs. Both are further developed during team meetings and reports. Final oral reports and a demonstration of the robotic device occur in week 15. Offered as BIOL 377, EMAE 377, BIOL 467, and EMAE 477. Counts as SAGES Senior Capstone.

EMAE 378. Mechanics of Machinery I. 3 Units.
Comprehensive treatment of design analysis methods and computational tools for machine components. Emphasis is on bearings, seals, gears, hydraulic drives and actuators, with applications to machine tools. Recommended preparation: EMAE 370. Offered as EMAE 378 and EMAE 478.

EMAE 382. Propulsion. 3 Units.

EMAE 383. Flight Mechanics. 3 Units.

EMAE 384. Orbital Dynamics. 3 Units.
Spacecraft orbital mechanics: the solar system, elements of celestial mechanics, orbit transfer under impulsive thrust, continuous thrust, orbit transfer, decay of orbits due to drag, elements of lift-off and re-entry. Rigid body dynamics, altitude dynamics and control, simulations.

EMAE 387. Vibration Problems in Engineering. 4 Units.

EMAE 390. Advanced Manufacturing Technology. 3 Units.
This course will focus on advanced design and manufacturing technologies and systems, with an emphasis on the total product life cycle and the challenges of secure and efficient product data management. Topics will include: traditional and rapid subtractive and additive prototyping and manufacturing technologies, design for manufacture (DFM), control and quality assurance of the design and manufacturing process, manufacturing system integration, "Globalization," and sustainable engineering. The course will be project-based and laboratory sessions will take place in the Reinberger and thinkbox studios. Prereq: EMAE 290.

EMAE 396. Special Topics in Mechanical and Aerospace Engineering. 1 - 18 Units.
(Credit as arranged.)

EMAE 397. Independent Laboratory Research. 1 - 3 Units.
Independent research in a laboratory.

EMAE 398. Senior Project. 3 Units.
Individual or team design or experimental project under faculty supervision. Requirements include periodic reporting of progress, plus a final oral presentation and written report. Recommended preparation: Senior standing, EMAE 360, and consent of instructor. Counts as SAGES Senior Capstone.

EMAE 399. Advanced Independent Laboratory Research/Design. 1 - 3 Units.
Students perform advanced independent research or an extended design project under the direct mentorship of the instructor. Typically performed as an extension to EMAE 397 or EMAE 398. Prereq: EMAE 397.

EMAE 400T. Graduate Teaching I. 0 Unit.
This course will engage the Ph.D. candidate in a variety of teaching experiences that will include direct contact (for example, teaching recitations and laboratories, guest lectures, office hours) as well non-contact preparation (exams, quizzes, demonstrations) and grading activities. The teaching experiences will be conducted under the supervision of the faculty member(s) responsible for coordinating student teaching activities. All Ph.D. candidates enrolled in this course sequence will be expected to perform direct contact teaching at some point in the sequence. Recommended preparation: Ph.D. student in Mechanical Engineering.

EMAE 401. Mechanics of Continuous Media. 3 Units.
Vector and tensor calculus. Stress and traction, finite strain and deformation tensors. Kinematics of continuous media, general conservation and balance laws. Material symmetry groups and observer transformation. Constitutive relations with applications to solid and fluid mechanics problems.

EMAE 402. Muscles, Biomechanics, and Control of Movement. 4 Units.
**EMAE 414. Nanobiomechanics in Biology. 3 Units.**
This course will elucidate the forces at play at the level of proteins including those associated with mass, stiffness, viscosity, thermal and chemical factors. Basic polymer mechanics within the context of biological molecules will be covered and structures of key proteins associated with mechanical functions, such as actin, myosin and the cell membrane will be explained. Generation of force by polymerization of filamentous proteins as well as motor proteins will be included. Interaction forces between proteins, DNA/RNA mechanics will also be elucidated. Besides lectures, there will be term long project assignments (outreach-based or detailed literature survey on a subject associated with nanomechanics of cells/proteins). Recommended Preparation: Mechanics of Materials, Thermodynamics, Statics, Introductory Level Differential Equations, Introductory Level Fluid Mechanics.

**EMAE 415. Introduction to Musculo-skeletal Biomechanics. 3 Units.**

**EMAE 421. Multiscale Modeling of Bio- and Bio-inspired Systems. 3 Units.**
Depending on who you ask, the topic of Multiscale Computational Modeling is either a hot topic or passé; multiscale modeling is either a key to deciphering cellular mechanisms, e.g., of organismal mechanobiology, or an impossibility due to the necessity of unlimited access to super computers and ultrahigh resolution imaging that allow for explicit definition of organ scale events at subcellular length and time scales (that require access to data storage of greater than terabyte scale databases). If you ask me, we are already "doing multiscale modeling", but new computational and experimental approaches are presenting opportunities to reach the goal of tying organ scale mechanical loading (physiological loading events) to cellular mechanisms of e.g. tissue modeling and remodeling during development, growth, aging, as well as in health and disease. In this graduate level class we will address one particular mechanobiological system as a case study (Spring 2013: Bone as a Biosystem) and then extrapolate approaches to student-driven, relevant biological, bio-inspired and medical problems. Typically graduate students participating in the class are developing computational models as part of their graduate research; tying the in the class topics to the student's research modeling serves as the "lab" for this class and the student reports on these activities both in class as well as in the initial review paper, the multiscale model to be developed by the student, and the final class paper which should be prepared for submission to a relevant journal. Students will keep a lab/modeling notebook throughout the course to develop the ideas and concepts introduced in the course in context of their own bio- or bio-inspired system of interest. The biological system of interest and the problem to be addressed will be developed using typical engineering problem approach rubrics (problem statement/hypothesis, governing equations, idealizations/assumptions, initial & boundary conditions, knows/unknowns, in/-dependent variables) to predict system behavior using a comp model. Recommended Preparation: Senior undergraduates in engineering recommended to have completed ENGR 225 and ECIV 310 and an engineering GPA above 3.25. Prereq: Senior undergraduates in Engineering, GPA greater or equal to 3.25.

**EMAE 424. Introduction to Nanotechnology. 3 Units.**
An exploration of emerging nanotechnology research. Lectures and class discussion on 1) nanostructures: superstructures, nanowires, nanotubes, quantum dots, nanoparticles, nanocomposites, proteins, bacteria, DNA; 2) nanoscale physical phenomena: mechanical, electrical, chemical, thermal, biological, optical, magnetic; 3) nanofabrication: bottom up and top down methods; 4) characterization: microscopy, property measurement techniques; 5) devices/applications: electronics, sensors, actuators, biomedical, energy conversion. Topics will cover interdisciplinary aspects of the field. Offered as EECS 424 and EMAE 424.

**EMAE 450. Advanced Mechanical Engineering Analysis. 3 Units.**
This course is intended to equip students with tools for solving mathematical problems commonly encountered in mechanical, fluid and thermal systems. Specific goals are to: i) Enable the student to properly categorize the problem in a variety of ways ii) Enable the student to identify appropriate approaches to solving the problem ii) Provide the student experience in applying some common methods for obtaining numerical solutions iii) Provide the student with understanding of trade-offs and expectations for the methods used. The course covers topics related to analytical and computational approaches to problems categorized in a variety of ways including: 1. Linear versus nonlinear problems 2) finite degrees of freedom v. infinite degrees of freedom, 3) equilibrium v. propagation v. eigenvalue problems, 4) direct formulations v. indirect formulations 5) analytical v. numerical solutions. The course will be built around specific examples from solid mechanics, dynamics, vibrations, heat transfer and fluid mechanics. The significance of the various categorizations will be developed as an ongoing part of the approach to solving the problems. Prereq: EMAE 350 or Requisites Not Met permission.

**EMAE 453. Advanced Fluid Dynamics I. 3 Units.**
Derivation and discussion of the general equations for conservation of mass, momentum, and energy using tensors. Several exact solutions of the incompressible Newtonian viscous equations. Kinematics and dynamics of inviscid, incompressible flow including free streamline theory developed using vector, complex variable, and numerical techniques.

**EMAE 454. Advanced Fluid Dynamics II. 3 Units.**

**EMAE 455. Advanced Thermodynamics. 3 Units.**
Basic ideas of thermodynamics and dominant methods of their development: operational, postulational, and statistical. Entropy and information theory. Irreversible thermodynamics. Applications.
Microscale technologies have enabled advanced capabilities for researchers in unexplored territories of cells in biology and medicine. Biological (or Biomedical) Micro-Electro-Mechanical Systems (MEMS) and Biomanufacturing involve the fundamentals of mechanics, electronics and advanced microfabrication technologies with specific emphasis on biological applications. MEMS is an interdisciplinary research area which brings together multiple disciplines including, mechanical engineering, biomedical engineering, chemical engineering, materials science, electrical engineering, clinical sciences, medicine, and biology. MEMS based technologies have found real world applications in tissue engineering, implantable microdevices, proteomics, genomics, molecular biology, and point-of-care platforms. This course aims to: (1) introduce the need for miniaturized systems in biology and medicine and the fundamental design and microfabrication concepts, (2) introduce the basics of microscale manipulation of cells, biological agents, and biomanufacturing, employing the fundamentals of microscale behaviors of fluids and mechanical systems, (3) expose the students to applications of MEMS and on-chip technologies in biology and medicine.

EMAE 457. Combustion. 3 Units.
Chemical kinetics and thermodynamics; governing conservation equations for chemically reacting flows; laminar premixed and diffusion flames; turbulent flames; ignition; extinction and flame stabilization; detonation; liquid droplet and solid particle combustion; flame spread, combustion-generated air pollution; applications of combustion processes to engines, rockets, and fire research.

EMAE 459. Advanced Heat Transfer. 3 Units.
Analysis of engineering heat transfer from first principles including conduction, convection, radiation, and combined heat and mass transfer. Examples of significance and role of analytic solutions, approximate methods (including integral methods) and numerical methods in the solution of heat transfer problems. Recommended preparation: EMAE 463.

EMAE 460. Theory and Design of Fluid Power Machinery. 3 Units.
Fluid mechanic and thermodynamic aspects of the design of fluid power machinery such as axial and radial flow turbomachinery, positive displacement devices and their component characterizations. Recommended preparation: Consent of instructor.

EMAE 461. Chemistry of Fire Safe Polymers and Composites. 3 Units.
Chemistry of Fire Safe Polymers and Composites starts with the introduction of characterization techniques used for fire safe materials and combustion phenomena research. General discussion on how reduced flammability of polymers and composites are obtained, for example by additives and preparing intrinsically thermally stable chemical structure and some examples of smart approaches, will be discussed. It also discusses the synthetic methods of preparing high temperature stable polymers in addition to the raw materials used to prepare those materials. Special emphasis will be placed on the thermal stability data obtained by thermogravimetric analysis (TGA) and combustion calorimetry for those fire safe materials. Mechanistic aspects of the flammability of polymers will be explained with special emphasis on the molar contribution of chemical functionality to the heat release capacity. Theoretical derivation of thermokinetic parameters will be explained. In addition, a common sense build-up will be attempted by providing actual numbers associated with those thermokinetic parameters. Upon completion of background formation, a more advanced materials, composites and nanocomposites, will be discussed using the results recently reported. Preliminary attempts to explain flame retardation by nanocomposite structures will also be discussed. Offered as EMA 461 and EMAE 461.

EMAE 463. Fire Dynamics. 3 Units.
This course introduces compartment fires and burning behavior of materials. Topics include: buoyant driven flow, fire plume, ceiling jet, vent flow, flashover and smoke movement as well as steady burning of liquids and solids; ignition, extinction and flame spread over solids. Recommended Preparation: Elementary knowledge in thermo-fluids is required. Offered as EMAE 463 and EMAC 463. Prereq: EMAE 325 or Requisites Not Met permission.

EMAE 464. Fire Protection Engineering. 3 Units.
This course introduces essentials of fire protection in industry and houses. Topics include: hazard identification (release of flammable gases and their dispersion), fire and explosion hazards, prevention and risk mitigation, fire detection systems, mechanisms of fire extinguishment, evaluation of fire extinguishing agents and systems. Offered as EMA 464 and EMAE 464.

EMAE 466. Mechanics of Biological Fluids. 3 Units.
This is a senior/graduate level course which aims to provide a solid grasp of the role of mechanics in biological fluids and in the human circulatory system that will help in the research and design of new medical instruments, equipment, and procedures. The course will cover properties of Newtonian and non-Newtonian fluids, hydrostatic and dynamic forces, principles of continuity, conservation of mass, energy and momentum and their applications in biological fluids, laminar and turbulent flows and boundary layer, introduction to Navier Stokes, dimensional analysis and similarity, blood flow in the cardiovascular system, gas exchange in the pulmonary system, blood flow in microcirculation and vessels. Important concepts will be covered by case studies.

EMAE 471. Computational Fluid Dynamics. 3 Units.
EMAE 477. Biorobotics Team Research. 3 Units.
Many exciting research opportunities cross disciplinary lines. To participate in such projects, researchers must operate in multi-disciplinary teams. The Biorobotics Team Research course offers a unique capstone opportunity for undergraduate students to utilize skills they developed during their undergraduate experience while acquiring new teaming skills. A group of eight students form a research team under the direction of two faculty leaders. Team members are chosen from appropriate majors through interviews with the faculty. They will research a biological mechanism or principle and develop a robotic device that captures the actions of that mechanism. Although each student will cooperate on the team, they each have a specific role, and must develop a final paper that describes the research generated on their aspect of the project. Students meet for one class period per week and two 2-hour lab periods. Initially students brainstorm ideas and identify the project to be pursued. They then acquire biological data and generate robotic designs. Both are further developed during team meetings and reports. Final oral reports and a demonstration of the robotic device occur in week 15. Offered as BIOL 377, EMAE 377, BIOL 467, and EMAE 477. Counts as SAGES Senior Capstone.

EMAE 478. Mechanics of Machinery I. 3 Units.
Comprehensive treatment of design analysis methods and computational tools for machine components. Emphasis is on bearings, seals, gears, hydraulic drives and actuators, with applications to machine tools. Recommended preparation: EMAE 370. Offered as EMAE 378 and EMAE 478.

EMAE 480. Fatigue of Materials. 3 Units.

EMAE 481. Advanced Dynamics I. 3 Units.

EMAE 487. Vibration Problems in Engineering. 3 Units.

EMAE 488. Advanced Robotics. 3 Units.
This course will focus on up-to-date knowledge and theories related to robotics and multi-agent systems. Related mathematics and theories including group theory (Lie groups), rigid-body motions (SO(3) and SE(3)), kinematics, dynamics, and control will be studied. In addition, the class will also discuss structural, computational and task complexity in robotic systems based on combinatorial analysis, information theory, and graph theory. Lecture and discussion topics: Kinematics; Introduction to Group Theory and Lie Groups; Rigid-body Motions (SO(3), SE(3)); Multi-body Dynamical Systems: Order-N computational methods; Complexity Analysis for Robotic Systems; Structural complexity, information-theoretic complexity, and task complexity; Special Discussion Topics; Special discussion topics may vary each year. Students enrolled in this class will be required to conduct a final project. Two or three students will work as a team. The topics for student teams may include: computer simulation of multi-body dynamical systems, art robot design, and complexity analysis for coupled complex systems. The detailed information will be provided in the first week of the class. The final presentations and demonstrations will be held during the last week of class and will be open to the public audience. Students are also required to submit a final report following a IEEE conference paper template. Prereq: EMAE 181, EECs 246.

EMAE 489. Robotics I. 3 Units.

EMAE 500T. Graduate Teaching II. 0 Unit.
This course will engage the Ph.D. candidate in a variety of teaching experiences that will include direct contact (for example, teaching, recitations and laboratories, guest lectures, office hours) as well non-contact preparation (exams, quizzes, demonstration) and grading activities. The teaching experience will be conducted under the supervision of the faculty member(s) responsible for coordinating student teaching activities. All Ph.D. candidates enrolled in this course sequence will be expected to perform direct contact teaching at some point in the sequence. Recommended preparation: Ph.D. student in Mechanical Engineering.

EMAE 501. Constitutive Modeling of Solids. 3 Units.
Fundamentals of constitutive modeling of deformable solids. Hyperelastic, viscoelastic, plastic, and viscoplastic material responses and how microstructural mechanisms influence the macroscopic mechanical behavior in different materials. The course also aims at equipping students with necessary background to develop constitutive models that can be used in commercial/research finite element software for the analysis of complex structures and components. Prereq: EMAE 401.

EMAE 540. Advanced Dynamics II. 3 Units.

EMAE 552. Viscous Flow Theory. 3 Units.
Compressible boundary layer theory. Blowing and suction effects. Three-dimensional flows; unsteady flows. Introduction to real gas effects. Recommended preparation: EMAE 454.
EMAE 554. Turbulent Fluid Motion. 3 Units.

EMAE 557. Convection Heat Transfer. 3 Units.
Energy equation of viscous fluids. Dimensional analysis. Forced convection; heat transfer from non-isothermal and unsteady boundaries, free convection and combined free and forced convection; stability of free convection flow; thermal instabilities. Real gas effects, combined heat and mass transfer; ablation, condensation, boiling. Recommended preparation: EMAE 453 and EMAE 454.

EMAE 558. Conduction and Radiation. 3 Units.
Fundamental law, initial and boundary conditions, basic equations for isotropic and anisotropic media, related physical problems, steady and transient temperature distributions in solid structures. Analytical, graphical, numerical, and experimental methods for constant and variable material properties. Recommended preparation: Consent of instructor.

EMAE 560. Sustainable Manufacturing. 3 Units.
This course provides an in-depth presentation of a number of important topics related to sustainable design and manufacturing practices in industry. The topics covered include sustainable design and manufacturing from conventional metal cutting to emerging nanomanufacturing techniques. Some of the important goals of this course are: a. Students learn to understand the fundamental sustainable design and manufacturing methods and techniques. b. Students learn the cutting-edge theory and practices in sustainable design and manufacturing on improving the sustainability performance or developing sustainable products from real industrial practices. c. Students learn state-of-the-art knowledge on environmental impact assessment methods of industrial pollutants. d. Students apply the learned knowledge and skills in class discussions and project implementation. Prereq: EMAE 390.

EMAE 600T. Graduate Teaching III. 0 Unit.
This course will engage the Ph.D. candidate in a variety of teaching experiences that will include direct (for example, teaching recitations and laboratories, guest lectures, office hours) as well non-contact preparation (exams, quizzes, demonstrations) and grading activities. The teaching experience will be conducted under the supervision of the faculty member(s) responsible for coordinating student teaching activities. All Ph.D. candidates enrolled in this course sequence will be expected to perform direct contact teaching at some point in the sequence. Recommended preparation: Ph.D. student in Mechanical Engineering.

EMAE 601. Independent Study. 1 - 18 Units.

EMAE 649. Project M.S.. 1 - 6 Units.

EMAE 651. Thesis M.S.. 1 - 18 Units.

EMAE 689. Special Topics. 1 - 18 Units.

EMAE 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Division of Engineering Leadership and Professional Practice
312 Nord (7240)
http://engineering.case.edu/delpp/

The Division of Engineering Leadership and Professional Practice (http://engineering.case.edu/delpp) (DELPP) designs, develops and administers programs and opportunities which complement and enhance the curricular offerings in the Case School of Engineering. The DELPP staff is committed to serving all engineering undergraduate and graduate students. We work closely with students, faculty, staff, and off-campus organizational representatives to deliver experiences designed to promote excellence in engineering education.

Mission
The mission of the Division of Engineering Leadership and Professional Practice is to support, through teaching and educational research, the Case School of Engineering’s educational programs, student programs, and outreach activities at all academic levels: PreK-12, undergraduate, graduate, and continuing education.

The activities supported by DELPP include optional academic programs that enhance the engineering curriculum, such as Cooperative Education and the Dual Degree undergraduate programs, as well as global programs, leadership exposure and opportunities, and professional practice.

Cooperative Education for Undergraduate and Graduate Engineering Students (http://engineering.case.edu/coop)
Undergraduate Cooperative Education (http://engineering.case.edu/coop) is an academic program that enables students to alternate classroom studies with career based experiences in industry. It is a learning experience designed to integrate classroom theory with practical experience and professional development. Co-op is a paid full-time work experience designed to maximize the student’s education. Co-op assignments are typically for two seven-month periods, each period consisting of a summer and a contiguous spring or fall semester. Co-op is available to students who have completed 4-5 semesters of coursework, in good academic standing, registered as a full-time student, and pursuing a degree in engineering, engineering physics, or physics. Registration in this course will serve to maintain full-time student status for the period of time that the student is on a co-op assignment.

Graduate Cooperative Education is an academic program designed for graduate students to enhance their classroom, laboratory, and research learning through participation and experience in various organizational/industrial environments where theory is applied to practice. Co-op is a paid full-time work experience for one seven-month period. Students must obtain approval from their academic advisor prior to accepting a co-op position. Graduate cooperative education experiences may be integrated with the student’s thesis or research project areas, or be solely for the purpose of gaining professional experience related to the student’s major field of study. Registration in this course will serve to maintain full-time student status for the period of time the student is on a co-op assignment. A large variety of companies hire and train the co-op students providing quality and challenging experiences. For additional information, please contact Genine Apidone (genine.apidone@case.edu) or 216.368.5024.
Dual Degree (3-2) Engineering Program
The Dual Degree (3-2) (http://engineering.case.edu/delpp/dualdegree) Engineering Program enables superior undergraduate students, enrolled at approximately forty participating liberal arts colleges in the continental United States and Puerto Rico, to combine a strong liberal arts foundation with the study of engineering. While enrolled at a cooperating liberal arts college, students complete courses in mathematics, chemistry, physics, and computer science in addition to studies in the humanities and social sciences. Students complete these courses during their first three years and must obtain the approval of the designated faculty liaison at the liberal arts college prior to admission to the Case School of Engineering.

Qualified candidates continue at the Case School of Engineering for an additional two years of concentrated coursework in an engineering field. At the conclusion of five years, two baccalaureate degrees are awarded: one from the liberal arts college and the other a Bachelor of Science degree from Case Western Reserve University. For additional information, please contact Deborah Fatica (deborah.fatica@case.edu) or 216.368.4449.

Engineering Academic Community Engagement
The DELPP develops strategic and intentional programming designed to engage students and promote a strong and supportive campus community.

Joint activities with faculty, alumni, staff and corporate sponsors include, but are not limited to: leadership opportunities in Engineering student organizations including National Engineers Week and the Dean's Student Advisory Committee, hands-on industry sponsored design competitions, and networking and mentoring with alumni and faculty.

Global Programs
Global Programs (http://engineering.case.edu/delpp/global-exchange) offer international opportunities for engineering students ranging from study abroad to short-term programs, internships and cooperative education experiences, and research opportunities. Participation in global activities optimizes the student's educational experience as well as contributes to their societal awareness. Exposure to global activities is a valuable asset for leadership positions within multinational corporations.

The Division of Engineering Leadership and Professional Practice designs and implements programs tailored to students’ interests. Currently, short term cultural and language immersion programs are offered in the summer at various international universities, with more being established. At the University of Botswana, a three-week engineering core course is taught, which intertwines engineering content with regional issues specific to sub-Saharan Africa. Additional Engineering core courses are being taught abroad during the summer.

The Case School of Engineering hosts many students from various countries which enables students to learn about and interact with various cultures. New programs and opportunities continue to develop for students.

On the graduate level, the Case School of Engineering is establishing partnerships with top-ranked international universities to host 3+1+1 students. This program enables students to receive a bachelor’s degree from their home university along with receiving a master’s degree from the Case School of Engineering.

Approximately 80% of the Case School of Engineering faculty collaborate with over one hundred universities and organizations in over thirty countries spanning six continents. For additional information, please contact Deborah Fatica (deborah.fatica@case.edu) or 216.368.4449.

PreK-12 Outreach
PreK-12 outreach is managed through the Leonard Gelfand STEM Center (http://gelfand.case.edu), a collaboration between the Case School of Engineering and the College of Arts and Sciences. The goals of the STEM Center are to (1) broaden participation in STEM fields by increasing the number and diversity of students in the STEM disciplines at Case Western Reserve University and elsewhere and (2) increase students’ scientific literacy through a variety of innovative STEM programs. The Gelfand STEM Center leverages the resources of Case Western Reserve University to engage pre-college students, teachers, and families in activities that introduce them to scientific practices and concepts, intended to inspire a lasting interest in science and engineering. For additional information, please contact Me’lani Labat Joseph (melani.joseph@case.edu) or 216.368.1651.

Degree Program in Engineering, Undesignated
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Marc Buchner, Associate Dean of Engineering
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Engineering (Undesignated)
The Case School of Engineering offers undesignated degrees at the undergraduate and graduate level.

Bachelor of Science in Engineering (Undesignated)
The Engineering (Undesignated) program prepares students who seek a technological background but do not wish to pursue pure engineering careers. For example, some needs in the public sector, such as pollution remediation, transportation, low-cost housing, elective medical care, and crime control could benefit from engineering expertise. To prepare for careers in fields that address such problems, the Engineering (Undesignated) program allows students to acquire some engineering background, and combine it with a minor in such programs as management, history of technology and science, or economics. This is not an ABET accredited program.

A student electing an undesignated degree must submit a clear statement of career goals supported by a proposed course schedule with written justification for the selections. These documents are to be submitted to the office of the dean in the Case School of Engineering. The program must be approved by the Associate Dean in the Case School of Engineering in consultation with representatives of the major and minor departments. A total of at least 129 semester credits are required for graduation.

Since each student’s program is unique, no typical curriculum can be shown. Every program must fulfill the requirements described below.
In addition to Engineering Core (p. 1072) and CWRU General Education (p. 1053) requirements, the program requires the following:

A minimum of two engineering elective courses selected from two of the following four groups:

**Thermodynamics or Physical Chemistry**
- **ECHE 363** - Therodynamics of Chemical Systems 3
- **EMAC 351 & EMAC 352** - Physical Chemistry for Engineering and Polymer Physics and Engineering 6
- **CHEM 301 & CHEM 302** - Introductory Physical Chemistry I and Introductory Physical Chemistry II 6

**Signals, systems or control**
- **ECHE 367** - Process Control 4
- **EECS 246 or EBME 308** - Signals and Systems 3-4
- **EECS 304** - Control Engineering I with Laboratory 3

**Materials science**
- **EBME 306** - Introduction to Biomedical Materials 3
- **EECS 321** - Semiconductor Electronic Devices 4
- **EMAC 270** - Introduction to Polymer Science and Engineering 3
- **EMSE 276** - Materials Properties and Design 3
- **EMSE 343** - Materials for Electronics and Photonics 3

**Economics, production systems or decision theory**
- **EECS 350** - Operations and Systems Design 3
- **EECS 352** - Engineering Economics and Decision Analysis 3
- **OPRE 345** - Decision Theory 3

**Major Field**
The major field within the Engineering (Undesignated) requirements must contain a minimum of 24 credit-hours of work in one of the following engineering fields:

- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Engineering Physics
- Materials Science and Engineering
- Polymer Science and Engineering
- Systems and Control Engineering

This work includes a senior project laboratory (3 credits minimum) and usually a course with a physical measurements laboratory.

**Minor Field**
The minor field within the Engineering (Undesignated) requirements must contain a minimum of 15 credit-hours. Minors should be developed with the help of the Associate Dean in the Case School of Engineering. Minor fields must be approved by the department offering the minor.

**Bachelor of Science in Engineering (Undesignated)**

**Suggested Program of Study**
The following is a suggested program of study, individual student programs will vary according to specialty track and individual interest. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu) (Student Information System).

**First Year**

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**Third Year**

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</table>
Major Concentration Course 3
Minor Concentration Course 3
Engineering elective 3
Open elective 3
Professional Communication for Engineers (ENGL 398)** 2
Professional Communication for Engineers (ENGR 398)** 1
Major Concentration Course 3
Major Concentration Course 3
Minor Concentration Course 3
Minor Concentration Course 3
Engineering elective 3
Year Total: 18 15

Fourth Year
Units
Fall Spring
Humanities or Social Science elective ** 3 3
Exxx 398 Engineering Senior Project ** 3 3
Major Concentration Course 3
Minor Concentration Course 3
Minor Concentration Course 3
Humanities or Social Science elective ** 3
Major Concentration Course 3
Major Concentration Course 3
Minor Concentration Course 3
Open elective 3
Year Total: 15 15

Total Units in Sequence: 129

Hours required for graduation: 129

* University general education requirement
** Engineering general education requirement
a One of these courses must be a humanities/social science course.

Cooperative Education (http://engineering.case.edu/coop)
Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

Five-Year Combined BS/MS Program
This program offers outstanding undergraduate students the opportunity to obtain an MS degree, with a thesis, in one additional year of study beyond the BS degree. (Normally, it takes two years beyond the BS to earn an MS degree.) In this program, an undergraduate student can take up to 9 credit hours that simultaneously satisfy undergraduate and graduate requirements. Typically, students in this program start their research leading to the MS thesis in the fall semester of the senior year. The BS degree is awarded at the completion of the senior year.

Application for admission to the five year BS/MS program is made after completion of five semesters of course work. Minimum requirements are a 3.2 grade point average and the recommendation of a faculty member of the department. Interested students should contact the Associate Dean of Academics, Case School of Engineering.

Master of Science in Engineering (Undesignated)
A student working toward an undesignated Master of Science degree in engineering must select a department. The student is responsible for submitting a Planned Program of Study via the Student Information System where it will be routed for appropriate approvals. The Planned Program of Study must contain a minimum of 9 semester hours of course work in the department approving the program. A minimum of 18 semester hours of course work for the degree must be at the 400 level or higher. The student must also meet all the requirements of the designated Master of Science degree in engineering.
College of Arts and Sciences

Case Western Reserve University’s College of Arts and Sciences (http://artsci.case.edu) combines a history of educational excellence with a commitment to innovation and discovery. Building on a 191-year-old tradition, the college traces its origins to several predecessor institutions, including Adelbert College, Flora Stone Mather College, Cleveland College, Western Reserve College, and Case Institute of Technology.

Today, the college offers educational and research programs in the arts and humanities, mathematics and natural sciences, and social sciences. It comprises 21 academic departments and 33 interdisciplinary programs and centers.

Brief History

Western Reserve College, the earliest of our predecessor institutions, was founded in 1826 in Hudson, Ohio, about 26 miles southwest of Cleveland. In 1882 the college moved to Cleveland, where it formed the basis for Western Reserve University. The institution expanded to include several professional and graduate schools in addition to its liberal arts programs. It also served as a magnet for other artistic, cultural, educational, medical, and scientific organizations, now its neighbors in the extraordinary setting known as University Circle.

Central to the heritage of the college are the traditions of the programs that preceded it: Adelbert College, as the men’s undergraduate unit of Western Reserve University was known after the move to Cleveland; Flora Stone Mather College, initially founded in 1888 as the Cleveland College for Women; and Cleveland College, founded in 1925 in downtown Cleveland to serve part-time and adult students. These three units, each with a distinguished history of scholarship and achievement, were brought together in 1972 under the revived name of Western Reserve College. The college took its present form in 1992, when undergraduate and graduate programs and research in the arts, humanities, and social sciences were united with those in the physical sciences to form the College of Arts and Sciences.

Since the early 19th century, the college and its predecessors have participated in important developments in higher education. Examples include:

Engagement in issues of social justice. Western Reserve College’s early years in Hudson saw debates between two groups, each opposing slavery. Colonizationists believed that liberated slaves should be resettled in Africa; abolitionists did not favor such a policy. After long and bitter conflict, supporters of the abolitionist movement carried the day.

Emergence of science. The college in Hudson was home to early and distinguished programs in astronomy and mathematics. Later, in 1887, Professor Edward Morley collaborated with Professor Albert Michelson of the Case School of Applied Science in a series of experiments that remain among the most significant in the history of physics.

Education of women. In the 1850s, the college’s Cleveland-based Department of Medicine awarded six of the first seven medical degrees granted to women in this country. The founding of the College for Women in 1888 was only the second instance of a separate “coordinate” college for women at a major university.

Demographic and technological change. Following World War II, enrollment in Cleveland College swelled with returning veterans. During this period, the introduction of new technologies and fields of study drove increasing demand for advanced education and research in a wide range of disciplines.

Undergraduate Programs

Undergraduates in the college can choose a major or minor from almost 60 programs, design their own courses of study, or enroll in integrated bachelor’s/master’s degree programs. The university offers great flexibility to students wishing to pursue double majors in disparate fields, such as physics and studio art. In addition, students from all fields are eligible to participate in the college’s vibrant performing arts programs, including music and dance ensembles.

Beyond their course work, students are encouraged to conduct independent research within the college, in other units of the university, or in the scientific and cultural institutions of University Circle. They also have opportunities to engage in service learning projects and internships in research institutions, businesses, cultural institutions, and governmental agencies. With funding from the college’s Experiential Learning Fellowship programs, undergraduates may design and carry out ambitious research projects in Cleveland or across the globe.

Graduate Programs

The college’s graduate offerings include doctoral programs in 19 fields and several distinctive master’s programs. Through a partnership with Cleveland Play House, the Department of Theater has created one of the nation’s preeminent Master of Fine Arts programs in acting (http://theater.case.edu/graduate/master-of-fine-arts-in-acting). The Science and Technology Entrepreneurship Program (STEP) (http://step.case.edu) offers a three- or four-semester sequence of courses leading to a Master of Science degree in biotechnology, chemistry, or physics.

Centers in the College of Arts and Sciences

Baker-Nord Center for the Humanities

Established in 1996 with a generous endowment gift from Eric and Jane Nord, the Baker-Nord Center (http://humanities.case.edu) is dedicated to: 1) highlighting and celebrating the arts and humanities at Case Western Reserve University (art history and art, classics, English, history, modern languages and literatures, music, philosophy, religious studies, theater, and dance) through public lectures, panels, performances, and special programs; 2) supporting research and creative work in the humanities and arts through fellowships, grants, and symposia, as well as encouraging new and innovative directions in research and creativity, including the digital humanities, through public forums and open discussion; and 3) facilitating cross-disciplinary and inter-disciplinary collaborations among Case Western Reserve University faculty and members of other University Circle institutions that address questions and problems of broad human interest, within and outside of the academy.

Center for Education and Research in Cosmology and Astrophysics

The Center for Education and Research in Cosmology and Astrophysics (http://www.case.edu/origins/sciences/cosmology.html) (CERCA) is a center for the advancement and promotion of the scientific understanding of the origin and evolution of the universe and its contents, and their connection to fundamental physics. CERCA connects scientists and educators in the Departments of Physics and Astronomy.
and at the Shafran Planetarium of the Cleveland Museum of Natural History (CMNH). It draws together theoretical and experimental physicists and astrophysicists with observational astronomers to explore the cosmos and, together with partner educators, to communicate their excitement and knowledge to students and to the world at large. CERCA is also a partner in the Institute for the Science of Origins, a partnership of Case Western Reserve, CMNH, and ideasteam to advance and promote knowledge in a wide range of origins sciences.

Center for Policy Studies
The Center for Policy Studies (http://policy.case.edu) has four objectives: 1) to make Case Western Reserve University a more attractive and rewarding institution for students and faculty who wish to learn about and engage in the creation of public policy; 2) to raise the public profile of the university by sponsoring programs and other activities that publicize and increase the reach of the work of CWRU's policy analysts and their guests; 3) to contribute to the wider community by disseminating information and analysis of policy issues as generated both by faculty and by guests we bring to campus; and 4) to encourage creation of a community of policy studies on campus that may serve in the future as the basis for further development of policy-oriented curriculum at both the undergraduate and graduate levels.

Center for Research on Tibet
The Center for Research on Tibet (http://www.case.edu/affil/tibet) at Case Western Reserve University was founded in 1987 and is administered within the Department of Anthropology. The center's goal is to conceptualize and conduct research on Tibetan history, society, language, ecology/physiology, and culture so as to understand traditional Tibet and the manner in which it has changed.

Leonard Gelfand STEM Center
The Leonard Gelfand STEM Center (http://www.case.edu/arts/sci/csm) links the resources of the College of Arts and Sciences - including faculty, staff, and students - with needs in the K-12 STEM community. Its collaborations with external partners, including schools and public libraries, park systems, and science museums, enhance instruction and generate student interest in the STEM fields of science, technology, engineering, and mathematics. The center hosts the annual Northeast Ohio Regional Science Olympiad, conducts a summer Shipwreck Camp that includes lessons in meteorology and marine geology, and engages middle school students in biological fieldwork in its Environmental Heroes Program. Through the Gelfand Science and Engineering Fair Program, it provides support for science fairs in Northeast Ohio schools, and it recruits and trains undergraduates to assist younger students with their science fair projects. In addition, the center participates in the university's Robert Noyce Teacher Scholarship Program, which provides mentoring and other support for future math and science teachers.

Center for the Study of Writing
The Center for the Study of Writing (http://www.case.edu/writing/csw) (CSW) is a flexible, cross-disciplinary center that fosters connections between innovative writing research and sound pedagogical practices, and between specialized faculty expertise and the needs and interests of aspiring undergraduate and graduate students.

Dittrick Medical History Center
The Dittrick Medical History Center (http://www.case.edu/arts/sci/dittrick/museum) is comprised of the Dittrick museum, archives, and collections of rare books, artifacts, and images. The center originated as part of the Cleveland Medical Library Association (est. 1894) and today functions as an interdisciplinary study center within the College of Arts and Sciences.

Ernest B. Yeager Center for Electrochemical Sciences
The mission of the Ernest B. Yeager Center for Electrochemical Sciences (http://www.case.edu/arts/sci/chem/yces) (YCES) is: 1) to enhance the education and training of students in fundamental and applied aspects of electrochemistry; 2) to provide a national and international resource for the dissemination of electrochemical knowledge within industrial, laboratory, and academic communities and to the general public and to support the continuing education of professional electrochemists; (3) to promote interactions between electrochemists and their research colleagues through seminars and symposia; and 4) to foster the improvement of the environment and human welfare through research in the design of materials and the development of processes and devices that will positively influence fields from medicine and microelectronics to energy conversion and energy storage.

Schubert Center for Child Studies
The Schubert Center for Child Studies (http://schubertcenter.case.edu/home.aspx) aims to strengthen links between child-related academic study, public policy formation, and professional practice. The Schubert Center convenes experts from across campus and throughout the Cleveland community to provide an innovative forum for multidisciplinary education, research, and communications focused on child policy.

Skeletal Research Center
The mission of the Skeletal Research Center (http://www.case.edu/artsci/biol/skeletal) (SRC) is to facilitate the advancement of basic research and to accelerate the translation of this new information into innovative clinical strategies for the regeneration and maintenance of skeletal tissues. Based in the Department of Biology, the center provides an organizational umbrella for the creative and innovative interactions of faculty. Although members of our faculty have long been recognized as leaders in skeletal research, the center was established in 1986 to draw these individuals together into a multidisciplinary group which could jointly approach current basic research and clinical problems. SRC is an administrative entity under the dean of the College of Arts and Sciences and the dean of the School of Medicine.

Administration
Cyrus C. Taylor, PhD
(Massachusetts Institute of Technology)
Dean and Albert A. Michelson Professor in Physics

Stephen E. Haynesworth, PhD
(Case Western Reserve University)
Associate Dean

Kurt Koenigsberger, PhD
(Vanderbilt University)
Associate Dean

Jill E. Korbin, PhD
(University of California, Los Angeles)
Associate Dean

Peter J. Whiting, PhD
(University of California, Berkeley)
Associate Dean

Clarke Leslie, BA
(Wheaton College)
Associate Dean, Development and External Relations
Michael Householder, PhD  
(University of California, Irvine)  
Assistant Dean

Beth Trecasa, MA  
(University of Akron)  
Assistant Dean, Strategic Initiatives

Academic English Proficiency for International Graduate Students

717 Crawford Hall  
https://case.edu/international/AEP/  
Phone: 216.368.5671  
Kurt Koenigsberger, Associate Dean  
kurt.koenigsberger@case.edu

The Academic English Proficiency Certificate for International Graduate Students provides English language development for students who need to raise their scores on the Test of English as a Foreign Language (TOEFL), International English Language Testing System (IELTS), or equivalent evaluation, for acceptance into a CWRU graduate degree program. The successful applicant receives provisional acceptance into a graduate program, with the provision being satisfied by their achievement of the necessary language score. The program’s English language and speech production curriculum comprises two modules, each module lasting one semester and consisting of three three-credit courses. Students enroll in one module (one semester) or two modules (two semesters) depending on their incoming language achievement score. AEP students also enroll in a supplementary, non-credit-bearing workshop designed to assist students in engaging effectively at CWRU.

Department of Anthropology

238 Mather Memorial Building  
www.case.edu/artsci/anth  
Phone: 216.368.2264; Fax: 216.368.5334  
Lawrence Greksa, Department Chair  
lawrence.greksa@case.edu

Anthropology, with its broad comparative approach, is in a strategic position to contribute to the identification and resolution of many of the problems, both local and global, that challenge society today. The Department of Anthropology offers programs leading to both undergraduate (Bachelor of Arts) and graduate (Master of Arts, Doctor of Philosophy) degrees. In addition, the department offers joint graduate degree programs with Case Western Reserve University School of Medicine (MA or PhD/MPH and MA or PhD/MD). Students graduating with a BA in anthropology (http://www.case.edu/artsci/anth) normally must continue for the MA or PhD degree if they are interested in working as anthropologists.

Undergraduate Programs

Majors

The undergraduate major requires a minimum of 30 semester hours in anthropology. The undergraduate program provides a cross-cultural perspective on human behavior, culture, and biology. Students may choose from four major concentrations.

1. The General Anthropology Concentration provides training in three subdisciplines of anthropology. The first, sociocultural anthropology, emphasizes relationships among socioeconomic institutions, cultural ecology, health and medicine, religion and symbolism, individual psychological variables, and language. The second, physical anthropology, emphasizes human ecology and adaptability, human growth and development, nutritional adaptation, epidemiology, and human and nonhuman primate evolution. The third, archaeology, deals with the long sequences of independent sociocultural, technological, and ecological evolution that have taken place under diverse conditions.

2. The Medical Anthropology Concentration provides training in the three subdisciplines discussed above, but with a focus on their relationship to physical and mental health, illness, disease, and medicine.

3. The Physical Anthropology Concentration deals with the biological nature of humans past and present. Physical anthropologists look beyond purely biological phenomena to understand how biology, behavior, and environment interact. Most course work is in the subdiscipline of human biology, which seeks to understand those interactions by studying physiology, genetics, nutrition, and epidemiology in modern human populations throughout the world. The concentration also provides training in paleoanthropology, which documents the biological history of humans and, in conjunction with archaeology, analyzes those interactions for past humans.

4. The Archaeology Concentration focuses on the customs and daily life of people who lived in the past. Anthropologists excavate and analyze the material remains of the sites of human occupation. At the same time, archaeological research seeks to understand the evolution of culture and society by determining how and why changes in human society have occurred.

General Anthropology Concentration

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<td>ANTH 103</td>
<td>Introduction to Human Evolution</td>
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<td>ANTH 333</td>
<td>Roots of Ancient India: Archaeology of South Asia</td>
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<td>ANTH 349</td>
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<td>ANTH 353</td>
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<tr>
<td>ANTH 102</td>
<td>Being Human: An Introduction to Social and Cultural Anthropology</td>
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<tr>
<td>ANTH 103</td>
<td>Introduction to Human Evolution</td>
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<tr>
<td>ANTH 215</td>
<td>Health, Culture, and Disease: An Introduction to Medical Anthropology</td>
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<td>ANTH 319</td>
<td>Introduction to Statistical Analysis in the Social Sciences</td>
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<tr>
<td>Geographic area course, such as:</td>
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ANTH 312 Ethnography of Southeast Asia
ANTH 314 Cultures of the United States
ANTH 331 The Most Ancient Near East
ANTH 333 Roots of Ancient India: Archaeology of South Asia
ANTH 349 Cultures of Latin America
ANTH 353 Chinese Culture and Society

Three health/illness-related topics courses, such as: 9
ANTH 302 Darwinian Medicine
ANTH 306 The Anthropology of Childhood and the Family
ANTH 316 Current Global Health Events
ANTH 323 AIDS: Epidemiology, Biology, and Culture
ANTH 326 Power, Illness, and Inequality: The Political Economy of Health
ANTH 328 Medical Anthropology and Public Health
ANTH 335 Illegal Drugs and Society
ANTH 337 Comparative Medical Systems
ANTH 338 Maternal Health: Anthropological Perspectives on Reproductive Practices and Health Policy
ANTH 350 Culture, Science and Identity
ANTH 359 Introduction to International Health
ANTH 360 Global Politics of Fertility, Family Planning, and Population Control
ANTH 361 Urban Health
ANTH 365 Gender and Sex Differences: Cross-cultural Perspective
ANTH 366 Population Change: Problems and Solutions
ANTH 371 Culture, Behavior, and Person: Psychological Anthropology
ANTH 376 Topics in the Anthropology of Health and Medicine
ANTH 378 Reproductive Health: An Evolutionary Perspective

Approved anthropology electives 9
Total Units 30

Archaeology Concentration
ANTH 102 Being Human: An Introduction to Social and Cultural Anthropology 3
ANTH 103 Introduction to Human Evolution 3
ANTH 107 Archaeology: An Introduction 3
ANTH 319 Introduction to Statistical Analysis in the Social Sciences 3

Geographical area course, such as: 3
ANTH 312 Ethnography of Southeast Asia
ANTH 314 Cultures of the United States
ANTH 331 The Most Ancient Near East
ANTH 333 Roots of Ancient India: Archaeology of South Asia
ANTH 349 Cultures of Latin America
ANTH 353 Chinese Culture and Society

Three approved archaeology courses, such as: 9
ANTH 202 Archaeology of Eastern North America
ANTH 321 Methods in Archaeology
ANTH 324 Field Methods in Archaeology
ANTH 331 The Most Ancient Near East
ANTH 333 Roots of Ancient India: Archaeology of South Asia
ANTH 399 Independent Study (if approved by advisor)

Summer fieldwork
Approved anthropology electives 6
Total Units 30

Physical Anthropology Concentration
ANTH 102 Being Human: An Introduction to Social and Cultural Anthropology 3
ANTH 319 Introduction to Statistical Analysis in the Social Sciences 3

Geographic area course, such as: 3
ANTH 312 Ethnography of Southeast Asia
ANTH 314 Cultures of the United States
ANTH 331 The Most Ancient Near East
ANTH 333 Roots of Ancient India: Archaeology of South Asia
ANTH 349 Cultures of Latin America

Departmental Honors
This program is open to qualified majors in anthropology who have completed 15 hours of anthropology with a 3.25 GPA and who have an overall 3.0 GPA. Students should apply for the program in the fall semester of their junior year and, if approved, register for ANTH 391 Honors Tutorial and ANTH 392 Honors Tutorial in the spring of their junior year and the fall of their senior year.
Honors students are required to undertake a research project under the supervision of one or more faculty members and to present an acceptable research paper in the fall semester of their senior year. Students interested in the program should contact one of the department’s undergraduate advisors.

**Integrated Graduate Studies**

The Department of Anthropology participates in the Integrated Graduate Studies Program (p. 1078). Interested students can find the general requirements and the admission procedures for the program in the Undergraduate Studies section of this bulletin and may consult the department for further information.

**Minors**

The department offers four minor emphases in anthropology: general anthropology, medical anthropology, archaeology, and physical anthropology. All require a minimum of 15 semester hours in anthropology.

### General Anthropology Minor

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Approved electives: 6

Total Units: 15

### Medical Anthropology Minor

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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>ANTH 102</td>
<td>Being Human: An Introduction to Social and Cultural Anthropology</td>
<td>3</td>
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<tr>
<td>ANTH 103</td>
<td>Introduction to Human Evolution</td>
<td>3</td>
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<tr>
<td>ANTH 215</td>
<td>Health, Culture, and Disease: An Introduction to Medical Anthropology</td>
<td>3</td>
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One geographic area course, such as: 3

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<tbody>
<tr>
<td>ANTH 312</td>
<td>Ethnography of Southeast Asia</td>
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<tr>
<td>ANTH 314</td>
<td>Cultures of the United States</td>
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<tr>
<td>ANTH 331</td>
<td>The Most Ancient Near East</td>
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<tr>
<td>ANTH 353</td>
<td>Chinese Culture and Society</td>
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One health-related topics course, such as: 3

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<td>ANTH 316</td>
<td>Current Global Health Events</td>
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<tr>
<td>ANTH 323</td>
<td>AIDS: Epidemiology, Biology, and Culture</td>
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Total Units: 15

### Physical Anthropology Minor

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<tr>
<td>ANTH 333</td>
<td>Roots of Ancient India: Archaeology of South Asia</td>
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<tr>
<td>ANTH 353</td>
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Two approved physical anthropology electives, such as: 6

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<td>ANTH 323</td>
<td>AIDS: Epidemiology, Biology, and Culture</td>
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<tr>
<td>ANAT/ANTH 375</td>
<td>Human Evolution: The Fossil Evidence</td>
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<tr>
<td>ANAT 377</td>
<td>Human Osteology</td>
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<tr>
<td>ANTH 378</td>
<td>Reproductive Health: An Evolutionary Perspective</td>
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<tr>
<td>ANTH 396</td>
<td>Undergraduate Research in Evolutionary Biology</td>
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Total Units: 15

### Archaeology Minor

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<tr>
<td>ANTH 107</td>
<td>Archaeology: An Introduction</td>
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<tr>
<td>One geographic area course, such as:</td>
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<tr>
<td>ANTH 202</td>
<td>Archaeology of Eastern North America</td>
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One approved archaeology course, such as: 3
Graduate Programs
The Department of Anthropology offers graduate programs leading to the Master of Arts and Doctor of Philosophy degrees in anthropology with specializations in medical anthropology and global health.

The department also offers these combined degrees with the School of Medicine:
- MA or PhD/MPH
- MA or PhD/MD

Master of Arts
The purpose of the Master of Arts degree program is to prepare students to begin teaching, research, or service careers with a solid background in anthropology. Undergraduate course work in anthropology, while helpful, is not a prerequisite for admission.

The MA program is designed for two groups of students. First, students who enter the program with a BA and wish to obtain a PhD must obtain the MA before being admitted to the PhD program. This is accomplished in three semesters. Second, for those students who wish to obtain only an MA, it is possible to meet degree requirements in one year (two semesters). This program is designed for students who must complete the program in one year because they plan to enter a professional program, such as medical school, the following fall semester.

Requirements for the master’s degree include credit hour requirements, core course requirements, and a six-hour comprehensive written Master of Arts examination. A candidate for the master’s degree is required to complete 27 hours of class work, including an approved statistics course (3 hours) in which the student has earned a grade of C or better. No more than 6 credit hours of electives may be taken in 300-level courses (advanced undergraduate courses). All master’s degree candidates are required to attain a minimum cumulative grade point average of 3.0 in the core courses (described below) in order to qualify for the degree.

All master’s degree candidates are required to take the comprehensive written examination before the completion of 27 semester hours of graduate work. Written master’s degree examinations can receive one of three grades: High Pass, Pass, or Fail. “High Pass” signifies performance sufficient for both the Master of Arts degree and advancement to the Doctor of Philosophy program, provided other requirements have also been satisfied. “Pass” signifies performance adequate for the master’s degree but insufficient to enter the doctoral program. “Fail” means a performance inadequate for the master’s degree. In the case of grades of Pass and Fail, the written examination may be retaken once.

Doctor of Philosophy
The Doctor of Philosophy degree program includes specializations in medical anthropology and global health. It requires a minimum of 36 credit hours.
PhD students will work with their doctoral advisor and faculty committee to determine prior to completing candidacy exams what foreign language, if any, is needed to successfully complete the PhD. If language competency is required, the language requirement can be met by a demonstration of competency either in a relevant written language or in an oral field language. The advisor, in consultation with the committee, will determine the level of competency needed and by what means language proficiency will be certified. Certification of competency must occur prior to the dissertation defense.

Medical Anthropology and Global Health Program
The objective of the Medical Anthropology and Global Health Program is to train medical anthropologists, physicians, nurses, and other health professionals (1) to recognize and deal with, on both theoretical and practical levels, the complex relations between the biological, social, cultural, psychological, economic, and techno-environmental determinants and concomitants of sickness and health in both local and global settings; and (2) to analyze and evaluate how health services are organized and delivered.

Students are encouraged to obtain a Certificate in Global Health during their studies. The Certificate in Global Health was established as part of the Framework for Global Health Curricula, which is coordinated by the Center for Global Health and Diseases in the School of Medicine. This certificate program combines discipline-specific and interdisciplinary coursework to promote a broad understanding of global health issues. The one-year MA course schedule incorporates the requirements for the Global Health Certificate.

MA Requirements
The curriculum covers the range of medical anthropology interests: ethnomedicine, international health, urban health, psychiatric anthropology, human adaptation and disease, nutrition, social demography, and so on. All Master of Arts degree students in medical anthropology must complete 27 hours:

| ANTH 202 | Archaeology of Eastern North America |
| ANTH 321 | Methods in Archaeology |
| ANTH 324 | Field Methods in Archaeology |
| ANTH 331 | The Most Ancient Near East |
| ANTH 333 | Roots of Ancient India: Archaeology of South Asia |
| ANTH 399 | Independent Study (if approved by advisor) |

Summer fieldwork

Total Units 15

| Approved anthropology electives |
| **Total Units** 27 |

* Anthropology or other department offerings with advisor approval.
PhD Requirements
All PhD students in medical anthropology are required to complete the PhD requirements. Students develop a specific plan of study, requiring a minimum of 36 credit hours, in consultation with their advisor.

- Students must take an approved statistics course (3 credits) and earn a grade of C or better if this requirement has not been fulfilled at the MA level.
- Students must take ANTH 504 Anthropological Research Design
- Students must complete two approved seminars (500 level). ANTH 504 and ANTH 599 Tutorial: Advanced Studies in Anthropology do not count towards this requirement.
- Students may not take more than six total credit hours of ANTH 599.
- Students must take 18 credit hours in dissertation (ANTH 701 Dissertation Ph.D.) after completing a candidacy examination.

After completing course requirements, a student must take the written Doctor of Philosophy candidacy examination. This examination consists of two topical exams and a dissertation prospectus. The examination is designed and evaluated by the doctoral committee.

Joint-Degree Programs

MA or PhD/MPH Program with the School of Medicine
The joint MA or PhD/MPH program provides students with the opportunity to receive an anthropology graduate degree and a public health degree simultaneously. A combined public health/anthropology degree will be especially valuable to students interested in working in urban health or international health, or within health policy programs. The joint MA/MPH requires 54 credit hours (21 in anthropology and 33 in public health). The joint PhD/MPH requires an additional 18 credit hours in anthropology beyond the MA level and 18 hours of ANTH 701 Dissertation Ph.D., for a total of 90 credit hours. All joint-degree students will develop a program of study with their advisors in both anthropology and public health.

MA or PhD/MD Program with the School of Medicine
The objectives of the joint MA or PhD/MD program are to train unusually qualified students to conduct research on a broad range of bio-cultural problems, with emphasis on the relationship between medicine, ecology, subsistence variables, population dynamics, and disease epidemiology; and to identify and analyze sociocultural impediments to the successful introduction of effective functioning and evaluation of health care programs in diverse contexts. Applicants should make separate application for admission to the School of Medicine and the Department of Anthropology (through the School of Graduate Studies). Applications to the Department of Anthropology may include MCAT scores rather than GRE scores, in addition to other information indicated on the graduate school forms.

Department Faculty
Lawrence F. Greksa, PhD
(Pennsylvania State University)
Professor and Chair
Physical anthropology; human biology; growth and development; nutrition; demography; modernization; Polynesia; Andes; Old Order Amish

Katia M. Almeida-Tracy, PhD
(Federal University of Rio Janeiro)
Instructor
Cultural and social anthropology; cultures of Latin America and Brazil; globalization and socioeconomic development; visual anthropology, ethnoart, museums, and patrimony; contemporary youth cultures; Amazonian ethnology; anthropology and education

Cynthia Beall, PhD
(Pennsylvania State University)
Distinguished University Professor and Sarah Idell Pyle Professor of Anthropology; Co-Director, Center for Research on Tibet
Physical anthropology; adaptation to high-altitude hypoxia on the Andean, Tibetan, and East African plateau, genetics of human adaptation, evolutionary human biology, evolutionary medicine

Atwood D. Gaines, PhD
(University of California, Berkeley; University of California, Berkeley, School of Public Health)
Professor; Professor of Psychiatry and Professor of Bioethics, CWRU School of Medicine; Professor of Nursing, Frances Payne Bolton School of Nursing; Editor-in-Chief, Culture, Medicine and Psychiatry
Medical and psychiatric anthropology; cultural studies of science and medicine; cultural bioethics; religion; aging and dementia; social identity and health; United States; France and the Mediterranean

Melvyn C. Goldstein, PhD
(University of Washington)
John Reynolds Harkness Professor; Co-Director, Center for Research on Tibet; Professor of International Health, School of Medicine; Member, National Academy of Sciences
Sociocultural anthropology; global aging and global health; cultural ecology, modernization; and nationalism; anthropology and history; Tibet, China, Mongolia, Himalayas

Vanessa M. Hildebrand, PhD
(Washington University)
Assistant Professor
Sociocultural anthropology; maternal and reproductive health; science and technology studies; global health and global health policy; Southeast Asia, Indonesia, United States

Lee D. Hoffer, PhD
(University of Colorado, Denver; Washington University School of Medicine)
Associate Professor
Cultural and medical anthropology; drug addiction; psychiatric epidemiology; ethnographic research methods; complex systems; computational modeling; economic anthropology; United States

Jill E. Korbin, PhD
(University of California, Los Angeles)
Lucy Adams Leffingwell Professor; Associate Dean, College of Arts and Sciences; Director, Schubert Center for Child Studies; Co-Director, Childhood Studies Program; President-elect, Society for Psychological Anthropology
Cultural, medical, and psychological anthropology; culture and human development; child maltreatment and child well-being; neighborhood, United States; Old Order Amish
Janet McGrath, PhD  
(Northwestern University)  
Professor; Director of Graduate Programs; Associate Professor of International Health, School of Medicine  
Biomedical anthropology; anthropology of infectious disease; international and global health; AIDS; urban health; United States, Africa

Jim Shaffer, PhD  
(University of Wisconsin, Madison)  
Associate Professor  
Archaeology; Middle East, Central Asia, Indus Valley, India

Lihong Shi, PhD  
(Tulane University)  
Assistant Professor  
Sociocultural anthropology; reproduction, gender, marriage, and family relations; population aging and sex-ratio imbalance; China, East Asia

Adjunct Faculty
Nicole M. Burt, Ph.D.  
(University of Alberta, Edmonton)  
Adjunct Assistant Professor; Curator and Head of Human Health and Evolutionary Medicine, Cleveland Museum of Natural History  
Stable isotope biogeochemistry (diet and migration); chronic disease; human growth and development; forensics

Alanna Cooper, PhD  
(Boston University)  
Adjunct Assistant Professor; Director, Jewish Lifelong Learning, Laura and Alvin Siegel Lifelong Learning Center  
Jewish studies; Central Asia; history and memory; material culture

Jennifer Furin, MD  
(Harvard University; University of California)  
Adjunct Assistant Professor; Lecturer, Department of Global Health and Social Medicine, Harvard Medical School  
Medical anthropology; infectious diseases; HIV; TB; community health; health policy and programming; Haiti, Peru, former Soviet Union, Resotho, Rwanda

Bridget M. Haas, PhD  
(University of California, San Diego)  
Adjunct Assistant Professor  
Cultural, medical, and psychological anthropology; refugees and asylum seekers; migration and health; culture and trauma; violence; families and youth; United States

Yohannes Haile-Selassie Ambaye, PhD  
(University of California, Berkeley)  
Adjunct Professor; Curator and Head of Physical Anthropology, Cleveland Museum of Natural History  
Human evolution; Plio-Miocene mammalian evolution; Hominin paleoecology

David Kaawa-Mafigiri, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor  
Medical anthropology; global health; social patterning of health; community health interventions; major at-risk population study; migration and health; child protection; social protection; innovative social work and health sciences educational systems; East and Central Africa, Uganda

Brian G. Redmond, PhD  
(Indiana University)  
Adjunct Associate Professor; John Otis Hower Chair of Archaeology, Cleveland Museum of Natural History  
Eastern North American prehistory; origins of maize agriculture and sedentism in lower Great Lakes; Paleolithic bone modification; museum archaeology

Richard Currie Smith, PhD  
(University of Minnesota)  
Adjunct Assistant Professor  
Cultural ecology, anthropology and sustainability, semiotic/symbolic anthropology, medical semiotics; public health ecotourism; ecoadvertising; North American Prairie, Dakota (Sioux); modern Western culture

Secondary Faculty
Patricia A. Marshall, PhD  
(University of Kentucky)  
Professor, Department of Bioethics, School of Medicine  
Empirical bioethics research; informed consent to research; ethics in genetics research; genomic research in Africa; cross-cultural studies

Scott W. Simpson, PhD  
(Kent State University)  
Professor, Department of Anatomy, School of Medicine  
Miocene-Pleistocene hominin evolution; dental anthropology; human anatomy; functional anatomy

James C. Spilsbury, PhD  
(Case Western Reserve University)  
Assistant Professor and Director, Academic Development Core, Department of Epidemiology and Biostatistics, Center for Clinical Investigation, CWRU School of Medicine  
Cultural and medical anthropology; sleep, child maltreatment; United States

Emeriti
Charlotte Ikels, PhD  
(University of Hawaii)  
Professor Emerita  
Cross-cultural aging, lifecourse, death and dying, intergenerational relationships, urban life, comparative bioethics; China

Courses
ANTH 102. Being Human: An Introduction to Social and Cultural Anthropology. 3 Units.  
The nature of culture and humans as culture-bearing animals. The range of cultural phenomena including language, social organization, religion, and culture change, and the relevance of anthropology for contemporary social, economic, and ecological problems.

ANTH 103. Introduction to Human Evolution. 3 Units.  
Physical, cultural, and technological evolution of humans. The systematic interrelationships between humans, culture, and environment.
ANTH 107. Archaeology: An Introduction. 3 Units.
Basic archaeological concepts are discussed followed by a review of human cultural and biological evolution from the earliest times through development of state organized societies. Geographical scope is worldwide with special attention given to ecological and cultural relationships affecting human societies through time.

ANTH 202. Archaeology of Eastern North America. 3 Units.
This course is an introduction to the archaeology and prehistory of the eastern woodlands of North America. Course material will focus on the archaeological record of native societies living east of the Mississippi River from the first arrivals at the end of the Pleistocene up to the coming of Europeans. Specific topics for discussion include late Pleistocene settlement, hunter-gatherer environmental adaptations, the origin of food production, and the development of ranked societies.

ANTH 215. Health, Culture, and Disease: An Introduction to Medical Anthropology. 3 Units.
This course is an introduction to the field of Medical Anthropology. Medical Anthropology is concerned with the cross-cultural study of culture, health, and illness. During the course of the semester, our survey will include (1) theoretical orientations and key concepts; (2) the cross-cultural diversity of health beliefs and practices (abroad and at home); and (3) contemporary issues and special populations (e.g., AIDS, homelessness, refugees, women's health, and children at risk).

ANTH 225. Evolution. 3 Units.
Multidisciplinary study of the course and processes of organic evolution provides a broad understanding of the evolution of structural and functional diversity, the relationships among organisms and their environments, and the phylogenetic relationships among major groups of organisms. Topics include the genetic basis of micro- and macro-evolutionary change, the concept of adaptation, natural selection, population dynamics, theories of species formation, principles of phylogenetic inference, biogeography, evolutionary rates, evolutionary convergence, homology, Darwinian medicine, and conceptual and philosophic issues in evolutionary theory. Offered as ANTH 225, BIOL 225, EEPS 225, HSTY 225, and PHIL 225.

ANTH 233. Introduction to Jewish Folklore. 3 Units.
Exploration of a variety of genres, research methods and interpretations of Jewish folklore, from antiquity to the present. Emphasis on how Jewish folk traditions and culture give us access to the spirit and mentality of the many different generations of the Jewish ethnic group, illuminating its past and informing the direction of its future development. Offered as ANTH 233, RLGN 233, and JDST 233. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 300. International Project Field Work: Uganda, Global Health. 1 Unit.
Field trip to Uganda for design teams associated with ENGR 397/ANTH 303 and the Global Health Design Collaborative. Participation by instructor consent. A course fee will be assessed to cover travel and on-the-ground expenses. Offered as ENGR 350U and ANTH 300.

ANTH 302. Darwinian Medicine. 3 Units.
Darwinian medicine deals with evolutionary aspects of modern human disease. It applies the concepts and methods of evolutionary biology to the question of why we are vulnerable to disease. Darwinian (or evolutionary) medicine proposes several general hypotheses about disease causation including disease as evolutionary legacy and design compromise, the result of a novel environment, a consequence of genetic adaptation, the result of infectious organisms' evolutionary adaptations, and disease symptoms as manifestation of defense mechanisms. It proposes that evolutionary ideas can explain, help to prevent and perhaps help to treat some diseases. This course presents the basic logic of Darwinian medicine and evaluates hypotheses about specific diseases that illustrate each of the hypotheses about disease causation. Recommended preparation: ANTH 103. Offered as ANTH 302 and ANTH 402.

ANTH 303. Interdisciplinary Solutions to Global Health Issues. 3 Units.
This unique course brings together the expertise of engineers and social scientists to address global health issues through a combination of classroom-based learning and experiential learning through team-based design projects and field-based community assessments. Students will experience the process of engineering design by participating in teams organized around solutions to real-world health problems in the developing world. Methods from social sciences will be practiced and brought to bear in the process, including assessment of global health needs, and evaluation of success of interventions. Students will study and discuss current key issues in global health, and ethics surrounding health care, disparity, methods of intervention, and develop skills in how to define and frame problems and communicate effectively across disciplines. The course is organized around ongoing projects that seek to design technical solutions to global health issues, with a focus on Uganda. The teams will also work and learn with students and faculty of Biomedical Engineering and Social Sciences at Makerere University of Kampala (MUK), Uganda. Examples of interactions with MUK will include discussion of common readings, peer-review, and joint planning, implementation, and review of fieldwork. Students enrolled in ANTH 303/ENGR 397 are eligible to travel to Uganda to participate in project activities over Spring Break. Travelers must be enrolled in ENGR 350U. This course is an approved SAGES Departmental Seminar. A student in the Case School of Engineering may use this course to meet an Engineering Core Breadth requirement, either in place of ENGL 398 and ENGR 398, or as a Social Science course (ANTH 303 cross-list). No student may count the course to satisfy both of these requirements. Offered as ANTH 303 and ENGR 397. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 305. Child Policy. 3 Units.
This course introduces students to issues in public policy that impact children and families. Local, state, and federal child policy will be considered, and topics will include, for example, policies related to child poverty, education, child welfare, juvenile justice, and children's physical and mental health. Students will learn how policy is developed, how research informs policy and vice versa, and a framework for analyzing social policy. Recommended preparation: One social sciences course or consent. Offered as ANTH 305, CHST 301, and POSC 382A.

ANTH 306. The Anthropology of Childhood and the Family. 3 Units.
Child-rearing patterns and the family as an institution, using evidence from Western and non-Western cultures. Human universals and cultural variation, the experience of childhood and recent changes in the American family. Recommended preparation: ANTH 102. Offered as ANTH 306 and ANTH 406.
ANTH 307. Experiential Learning in Child Policy. 3 Units.
Focus on state and federal legislative policy impacting children, youth, and families. Course includes an experiential learning component at the state or federal level and a travel experience to either Columbus, OH or Washington, DC to learn firsthand how policy is formed. Students may take this course twice for credit. Offered as ANTH 307 and CHST 302.

ANTH 308. Child Policy Externship. 3 Units.
Exterships offered through CHST 398/ANTH 308 give students an opportunity to work directly with professionals who design and implement policies that impact the lives of children and their families. Agencies involved are active in areas such as public health, including behavioral health, education, juvenile justice, childcare and/or child welfare. Students apply for the externships, and selected students are placed in local public or nonprofit agencies with a policy focus. Each student develops an individualized learning plan in consultation with the Childhood Studies Program faculty and the supervisor in the agency. CHST 398/ANTH 308 is a 3 credit-hour course and may be taken twice for a total of 6 credit hours. Offered as CHST 398 and ANTH 308. Prereq: CHST 301.

ANTH 310. Introduction to Linguistic Anthropology. 3 Units.
This is an introduction to the core concepts, theories and methodologies that form the study of language from an anthropological point of view. The course provides exposure to current issues in linguistic anthropological research and reviews some of the foundational topics of research past, highlighting the contributions of linguistics to anthropology and social science. Topics to be explored include: 1) an overview of the study of language (language structure and patterns, the effects of linguistic categories on thought and behavior, meaning and linguistic relativity, cross-language comparison, and non-verbal communication); 2) doing linguistic anthropology "on the ground" (an intro to the laboratory and field techniques of linguistic anthropology); 3) the study of language as function and social action (language and social structure speech acts and events, verbal art, language and emotion); and 4) the study of language/discourse and power (language in politics, medicine, and law). Offered as ANTH 310 and ANTH 410.

ANTH 312. Ethnography of Southeast Asia. 3 Units.
This course examines the people and cultures of Southeast Asia from an anthropological perspective. From a starting place of the local people we will explore important aspects of life in this region such as agriculture, religion, health, medicine, nation-building, ethnic identity, art, and technology. Additionally, we will examine and question the ideas, traditions, and scholarly modes of study that brought this geographical area together as a region. Offered as ANTH 312 and ANTH 412. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 314. Cultures of the United States. 3 Units.
This course considers the rich ethnic diversity of the U.S. from the perspective of social/cultural anthropology. Conquest, immigration, problems of conflicts and accommodation, and the character of the diverse regional and ethnic cultures are considered as are forms of racism, discrimination, and their consequences. Groups of interest include various Latina/o and Native peoples, African-American groups, and specific ethnic groups of Pacific, Mediterranean, European, Asian, and Caribbean origin. Offered as ANTH 314, ETHS 314, and ANTH 414.

ANTH 316. Current Global Health Events. 3 Units.
This course will introduce students to an anthropological approach to understanding disease, illness, sickness and suffering in a global health context. The course will expose students to biological, socio-cultural, historical, political-economic, and epidemiological assessments of the disease and illness states. Students will be asked to bring a critical focus to the use of ethnographic, population-based, and clinical approaches to addresses global health problems. Additionally students will learn about the key organizations, institutions, and commercial enterprises that come to play in the assessment, prioritizing, and treatment of these health issues. Counts as SAGES Departmental Seminar. Prereq: ANTH 102 and ANTH 215.

ANTH 319. Introduction to Statistical Analysis in the Social Sciences. 3 Units.
Statistical description (central tendency, variation, correlation, etc.) and statistical evaluation (two sample comparisons, regression, analysis of variance, non-parametric statistics). Developing an understanding of statistical inference, particularly on proper usage of statistical methods. Examples from the social sciences. Cannot be used to meet the A&S Humanities and Social Sciences requirement. Not available for credit to students who have completed STAT 201, STAT 201R, or PSCL 282. Counts for CAS Quantitative Reasoning Requirement. Prereq: Major in Anthropology.

ANTH 321. Methods in Archaeology. 3 Units.
This course reviews the basic methods and techniques used in modern anthropological archaeology. Topics to be discussed include the nature of the archaeological record, research design, techniques of field archaeology, methods of laboratory analysis, museum archaeology, ethnoarchaeology, and cultural interpretation. Prereq: ANTH 107.

ANTH 323. AIDS: Epidemiology, Biology, and Culture. 3 Units.
This course will examine the biological and cultural impact of AIDS in different societies around the world. Topics include: the origin and evolution of the virus, the evolutionary implications of the epidemic, routes of transmission, a historical comparison of AIDS to other epidemics in human history, current worldwide prevalences of AIDS, and cultural responses to the epidemic. Special emphasis will be placed on the long-term biological and social consequences of the epidemic. Recommended preparation: ANTH 102 or ANTH 103 or ANTH 105. Offered as ANTH 323 and ANTH 423.

ANTH 324. Field Methods in Archaeology. 3 - 4 Units.
This field course is designed to give the student a comprehensive introduction to archaeological field work. All participants will be introduced to the methods of archaeological survey, techniques of hand excavation, artifact identification, and the preparation of field notes and documentation. In large measure this is a "learning through doing" course which is supplemented by formal and informal lectures and discussions about archaeological methods and regional prehistory. The course will take place from Monday through Friday at an archaeological site in northeast Ohio. Students are responsible for their own transportation to and from the field site and must bring a sack lunch. All participants will receive a field manual which will provide detailed information on the course and techniques of field work.
ANTH 325. Economic Anthropology. 3 Units.
Economic anthropology is a sub-field of anthropology that examines how people in modern and non-modern societies produce, distribute, exchange, and consume goods, services, and other valued resources. The sub-field seeks to understand how cultures, including our own, organize and structure these activities through institutions, rituals, and beliefs systems. However, unlike the formal approach of the field of economics, the in-depth methods of economic anthropology concentrate on day-to-day experiences of what the economic means, how this is defined, and what we can learn about human behavior through it. This course will introduce students to economic anthropology and some of the major questions and challenges this field addresses. The history of this sub-field, how it relates to economic sociology, and areas where economic anthropology and traditional economics overlap, will also be explored.
This class does not present economic anthropology and modern economics as adversaries, instead how and why they are fundamentally different orientations with often seemingly little in common. On this backdrop, this class will survey a number of different topics, including: health commodification; gift exchange; commodity chains; the history of money and debt; why objects have value; how people make ends meet; rational vs. non-rational decision-making; behavioral economic experiments conducted in other cultures; development economics, and why some objects and services have prices while others do not. Offered as ANTH 325 and ANTH 425.

ANTH 326. Power, Illness, and Inequality: The Political Economy of Health. 3 Units.
This course explores the relationship between social inequality and the distribution of health and illness across class, race, gender, sexual orientation, and national boundaries. Class readings drawn from critical anthropological approaches to the study of health emphasize the fundamental importance of power relations and economic constraints in explaining patterns of disease. The course critically examines the nature of Western biomedicine and inequality in the delivery of health services. Special consideration is given to political economic analysis of health issues in the developing world such as AIDS, hunger, reproductive health, and primary health care provision. Recommended preparation: ANTH 102 or ANTH 215. Offered as ANTH 326 and ANTH 426.

ANTH 327. Ancient Cultures of the Ohio Region. 3 Units.
This course surveys the archaeology of Native American cultures in the Great Lakes region from ca. 10,000 B.C. to A.D. 1700. The geographic scope of this course is the upper Midwest, southern Ontario, and the St. Lawrence Valley with a focus on the Ohio region. Recommended preparation: ANTH 107. Offered as ANTH 327 and ANTH 427.

ANTH 328. Medical Anthropology and Public Health. 3 Units.
Anthropology has a longstanding relationship with the field of public health, which dates back to before the flourishing of medical anthropology as a subfield. Direct participation of medical anthropologists in public health research and practice continues to grow. This course explores the intersection of medical anthropology and public health from the perspective of anthropological history, theory, and methods. Course topics include: the history of anthropological work in public health, medical anthropology theory as a guide to anthropological public health research, and anthropological methods and approaches to public health work. Case studies from around the world will be employed throughout the course. Offered as ANTH 328 and ANTH 428.

ANTH 329. Anthropological Perspectives of Migration and Health. 3 Units.
This course provides an overview of anthropological perspectives on transnational migration and health. We will focus particularly on health and health care issues concerning refugees, asylum seekers and undocumented migrants. This course will focus on the following topics: the physical and mental health consequences of forced migration; refugee trauma; the intersection of health care and immigration policies; immigration and health care access and utilization. Readings and coursework will consider the sociocultural, political, and economic factors that contribute to migrant health disparities. We will also address issues of medical pluralism among transnational migrants and critically examine the concept of cultural competence in clinical settings. Class readings will comprise a variety of theoretical and ethnographic literature within anthropology and closely related disciplines, drawing on cases from across the globe and in cross-cultural comparison. The class will use lectures, readings, and class discussions to explore these relevant issues in migration and health, with the opportunity to engage in hands on ethnographic work with refugees locally. Offered as ANTH 329 and ANTH 429.

ANTH 331. The Most Ancient Near East. 3 Units.
The Near East, archaeologically, is the most intensely researched area in the world. The research, spanning 150 years, reveals a continuous record of human adaptation spanning two million years, five human species, multiple major environmental changes, and shifts in human adaptive strategies from nomadic hunting and gathering to sedentary village agriculture and the emergence of urban centers “civilization.” The archaeological record of this extraordinary period beginning two million years ago until about 4000 BC is reviewed. Emphasis is placed on the human response to social and ecological changes. The course examines how the emergence of sedentary settlements, surplus food production, population growth, interregional trade, and social-economically stratified societies fundamentally changed the human condition. Recommended preparation: ANTH 102 or ANTH 107.

ANTH 333. Roots of Ancient India: Archaeology of South Asia. 3 Units.
Archaeological discoveries in South Asia (modern India, Pakistan, Sri Lanka, Bangladesh, and Nepal) reveal a continuous record of human habitation from almost two million years ago until the present. Early human populations in the region encountered dramatically changing ecological conditions resulting in various cultural adaptations over this long period. Beginning with the earliest hunter-gatherer populations, archaeological data reveal a diversity of cultural changes/adaptations in South Asia resulting in the indigenous development of sedentary agricultural societies coexisting with hunters and gatherers, and with pastoral nomadic groups interacting over diverse ecologies. These cultural developments resulted in the formation of the Harappan (Indus Valley) culture - a unique, ancient (2600-1300 BC) Old World civilization. Archaeological data indicate this Harappan culture provided basic fundamental cultural traits that evolved into the culturally Early Historic Indian Tradition. Special attention is given to theoretical controversies surrounding the cultural continuity issue in South Asian culture history and its significance for understanding Old World archaeology. Recommended preparation: ANTH 102 or ANTH 107.
ANTH 335. Illegal Drugs and Society. 3 Units.
This course provides perspectives on illegal drug use informed by the social, political and economic dimensions of the issues. Framed by the history, epidemiology, and medical consequences of drug use, students will confront the complex challenges posed by addiction. Anthropological research conducted in the U.S. and cross-culturally will demonstrate, elaborate and juxtapose various clinical, public health, and law enforcement policies and perspectives. Topics examined will include: why exclusively using a bio-medical model of addiction is inadequate; how effective is the war on drugs; what prevention, intervention and treatment efforts work; and various ideological/moral perspectives on illegal drug use. Offered as ANTH 335 and ANTH 435.

ANTH 337. Comparative Medical Systems. 3 Units.
This course considers the world’s major medical systems. Foci include professional and folk medical systems of Asia and South Asia, North and South America, Europe and the Mediterranean, including the Christian and Islamic medical traditions. Attention is paid to medical origins and the relationship of popular to professional medicines. The examination of each medical tradition includes consideration of its psychological medicine and system of medical ethics. Recommended preparation: ANTH 215. Offered as ANTH 337 and ANTH 437.

ANTH 338. Maternal Health: Anthropological Perspectives on Reproductive Practices and Health Policy. 3 Units.
The reproductive process is shared by humans as biological beings. However, the experience of pregnancy and childbirth is also dependent on the cultural, social, political, historical, and political-economic setting. This course frames issues in reproductive health by looking at the complex issues associated with maternal health and mortality worldwide. After reviewing biomedical perspectives on reproductive processes this course will focus on childbirth and pregnancy as the process and ritual by which societies welcome new members. This course will review ethnomedical concepts; discuss the interaction between local, national, and global agendas shaping reproductive practices; and conclude with anthropological critiques of reproductive health initiatives. Offered as ANTH 338 and ANTH 438.

ANTH 339. Ethnographic and Qualitative Research Methods. 3 Units.
This is a course on applying ethnographic research methods in the social sciences. Ethnographic research seeks to understand and describe the experiences of research participants (i.e. subjects) through becoming involved in their daily lives. Findings from ethnography are generated through systematic observation within the natural context in which behavior occurs (i.e. fieldwork). Unlike methods that emphasize detachment, distance, and objectivity, ethnography involves developing knowledge by becoming an ad hoc member of the group(s) one is studying. The principal techniques of ethnography, “participant-observation” and “in-depth open ended interviewing,” require actively engaging the research process. This class will explore ethnographic research techniques, as well as other qualitative research methods. In addition to addressing how such methods make claims about social phenomena, this class will also explore more practical topics such as: developing questions, entering the field, establishing rapport, taking and managing field notes, coding data, and data analysis. Lectures, readings, and class discussion will be complimented by assignments using techniques. Offered as ANTH 339 and ANTH 439. Prereq: ANTH 102.

ANTH 340. Cultures of the World: Study Abroad. 3 Units.
ANTH 340 is a vehicle to allow anthropology courses taken during study abroad that have a primary focus on the culture of a specific society or geographic area to be accepted as equivalent to a CWRU course that meets the CAS Global and Cultural Diversity requirement. In order to be accepted as equivalent to ANTH 340 a course must (a) be taught in a department of anthropology or by an anthropologist in an allied department; and (b) cover the breadth of a culture. Courses focusing on one aspect of a society (economics, political structure, history, etc.) cannot be accepted as equivalent to ANTH 340. In order to verify that a course meets these requirements students must submit a course description and syllabus for the course to the Chair, Department of Anthropology. If a syllabus is not available in advance of the course, approval will be contingent on review of the course syllabus. This course will fulfill the CAS Global and Cultural Diversity requirement, as well as meet the geographic area requirement for Anthropology majors and minors. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 347. Cultural Ecology: An Epistemological Approach to Environmental Sustainability. 3 Units.
This course provides the understanding that the realm of human culture is where both the cause and cure of nearly all contemporary environmental sustainability challenges are found. This is because culture is the medium through which humans as living systems perceive, interpret, and act upon their environment. Through understanding principles that guide living systems and applying them to human/nature interaction in diverse cultures throughout the world, students develop an ecological epistemology, or way of knowing nature. This leads to more effective advocacy for environmental sustainability and an increasing depth in interaction with nature, particularly in the domains of aesthetics and the sacred. Offered as ANTH 347 and ANTH 447. Counts as SAGES Departmental Seminar. Prereq: ANTH 102.

ANTH 349. Cultures of Latin America. 3 Units.
The aim of this course is to consider cultural diversity and social inequality in contemporary Latin America from an anthropological perspective. A variety of aspects related to ethnicity, religion, music, gender, social movements, cuisine, urban spaces, violence, and ecology are considered in addition to current economic and political issues. These topics will be analyzed in relation to Latin America’s complex historical and social formation and its identity representations. The course takes under consideration various case studies in which not just local communities but also perceptions of national institutions and practices will be analyzed from pluralistic approaches (provided by either Latin American and non-Latin American researchers) that combine fieldwork, interviews and life experiences with textual and media sources. Special attention will be paid to contemporary global issues affecting Latin America. Offered as ANTH 349 and ANTH 449. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ANTH 102.

ANTH 350. Culture, Science and Identity. 3 Units.
This course in the Cultural Studies of Science focuses on the ways in which social identities are constructed and imagined in contemporary and historical sciences and medicines. In particular, the course will consider gender, ethnic, “racial,” class and age identities as these are (re)constructed over time in medical and natural scientific discourses across professional cultures. Attention is paid to the means by which notions of normality and abnormality and category specificity are created and altered and to the dynamics of discursive formations. The course also considers the social and medical consequences of specific constructions of biology in general and with respect to specific identities and social classifications. Offered as ANTH 350 and ANTH 450.
ANTH 353. Chinese Culture and Society. 3 Units.
Focuses on Chinese cultural and social institutions during the Maoist and post-Maoist eras. Topics include ideology, economics, politics, religion, family life, and popular culture. Recommended preparation: ANTH 102. Offered as ANTH 353 and ANTH 453. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 354. Health and Healing in East Asia. 3 Units.
This course examines the illness experiences and the healing practices in East Asia. After introducing the anthropological approaches to the study of medicine, this course will explore the practices of ethnomedicine and biomedicine, mental health, family planning and reproductive health, the experience of aging and care giving, infectious disease, environmental health, and biotechnology. By delving into the illness experiences and the healing practices in East Asia, the course will discuss issues related to medical pluralism, health inequality, biological citizenship, social stigmatization, and bioethics. Offered as ANTH 354 and ANTH 454. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 359. Introduction to International Health. 3 Units.
Critical health problems and needs in developing countries. Prevalence of infectious disease, malnutrition, chronic disease, injury control. Examines strategies for improvement of health in less developed countries. Recommended preparation: ANTH 102. Offered as ANTH 359 and ANTH 459.

ANTH 360. Global Politics of Fertility, Family Planning, and Population Control. 3 Units.
This course offers an anthropological examination of fertility behaviors around the world. In particular, it explores various historical, cultural, socioeconomic, political, and technological factors contributing to reproductive activities. After introducing the anthropological approaches to the study of fertility, the course will delve into the ways to regulate fertility in historical and contemporary times, various factors contributing to fertility change, state intervention in reproduction through voluntary and coercive family planning programs, and new reproductive technologies and ethical concerns surrounding assisted reproduction and abortion. Offered as ANTH 360, ANTH 460 and WGST 360.

ANTH 361. Urban Health. 3 Units.
This course provides an anthropological perspective on the most important health problems facing urban population around the world. Special attention will be given to an examination of disparities in health among urban residents based on poverty, race/ethnicity, gender, and nationality. Offered as ANTH 361 and ANTH 461.

ANTH 362. Contemporary Theory in Anthropology. 3 Units.
A critical examination of anthropological thought in England, France and the United States during the second half of the twentieth century. Emphasis will be on the way authors formulate questions that motivate anthropological discourse, on the way central concepts are formulated and applied and on the controversies and debates that result. Readings are drawn from influential texts by prominent contemporary anthropologists. Recommended preparation: ANTH 102. Offered as ANTH 362 and ANTH 462.

ANTH 365. Gender and Sex Differences: Cross-cultural Perspective. 3 Units.
Gender roles and sex differences throughout the life cycle considered from a cross-cultural perspective. Major approaches to explaining sex roles discussed in light of information from both Western and non-Western cultures. Offered as ANTH 365, ANTH 465 and WGST 365. Prereq: ANTH 102 or consent of department.

ANTH 366. Population Change: Problems and Solutions. 3 Units.
The course examines population processes and their social consequences from an anthropological perspective. It introduces basic concepts and theories of population studies and demonstrates the ways in which anthropological research contributes to our understanding of population issues. We will explore questions such as: How has world population changed in history? How does a population age or grow younger? What are the factors affecting population health? Why do people migrate? And what are the policy implications of population change? We will examine the sociocultural, economic, political, and ecological factors contributing to population processes, such as factors affecting childbearing decisions, cultural context of sex-selective abortion, various caregiving arrangements for the elderly, and policy responses to population change. We will explore these issues with cases from across the world, with a special focus on China, the world's most populous country with the most massive family-planning program in modern human history. Offered as ANTH 366 and ANTH 466.

ANTH 367. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467. Prereq: ANTH 225 or equivalent.

ANTH 368. Evolutionary Biology Capstone. 3 Units.
This course focuses on a special topic of interest in evolutionary biology that will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. Students will participate in discussions and lead class seminars on evolutionary topics and in collaboration with an advisor or advisors, select a topic for a research paper or project. Each student will write a major research report or complete a major project and will make a public presentation of her/his findings. Offered as ANTH 368, BIOL 369, and PHIL 368. Counts as SAGES Senior Capstone. Prereq: ANTH 225, BIOL 225, EEPS 225, HSTY 225, PHIL 225 or its equivalent or permission of instructor.

ANTH 370. Field Seminar in Paleoanthropology. 12 Units.
Paleoanthropology is the study of human physical and cultural evolution based on fossils and cultural remains from ancient geological times. These fossils and cultural remains are collected by conducting fieldwork in various parts of the world where geological phenomena have exposed fossiliferous sedimentary windows from the deep past. Hence, fieldwork is one of the major backbones of paleoanthropology. This course is designed for advanced undergraduate students who are interested in pursuing higher degrees in paleoanthropology, human paleobiology, evolutionary biology, or other related disciplines. This course introduces students to the principles and methods of paleontological fieldwork in real time. It introduces students to paleoanthropological fieldwork from locating fossiliferous areas based on aerial photo interpretations to survey methodology, from methods of systematic excavation, fossil collection and documentation in the field, to curation and preparation of fossil specimens in laboratories; from conducting scientific analyses in laboratory environments to subsequently publishing the results in peer-reviewed journals. Recommended preparation: ANTH 377. Prereq: ANTH 103 and ANTH 375.
ANTH 371. Culture, Behavior, and Person: Psychological Anthropology. 3 Units.
Cross-cultural perspectives on personality, human development, individual variability, cognition, deviant behavior, and the role of the individual in his/her society. Classic and contemporary anthropological writings on Western and non-Western societies. Recommended preparation: ANTH 102. Offered as ANTH 371 and ANTH 471.

ANTH 372. Anthropological Approaches to Religion. 3 Units.
The development of, and current approaches to, comparative religion from an anthropological perspective. Topics include witchcraft, ritual, myth, healing, religious language and symbolism, religion and gender, religious experience, the nature of the sacred, religion and social change, altered states of consciousness, and evil. Using material from a wide range of world cultures, critical assessment is made of conventional distinctions such as those between rational/irrational, natural/supernatural, magic/religion, and primitive/civilized. Recommended preparation: ANTH 102. Offered as ANTH 372, RLGN 372 and ANTH 472.

ANTH 375. Human Evolution: The Fossil Evidence. 3 Units.
This course will survey the biological and behavioral changes that occurred in the hominid lineage during the past five million years. In addition to a thorough review of the fossil evidence for human evolution, students will develop the theoretical framework in evolutionary biology. Recommended preparation: ANTH 377, BIOL 225. Offered as ANAT 375, ANTH 375, ANAT 475 and ANTH 475. Prereq: ANTH 103.

ANTH 376. Topics in the Anthropology of Health and Medicine. 3 Units.
Special topics of interest, such as the biology of human adaptability; the ecology of the human life cycle; health delivery systems; transcultural psychiatry; nutrition, health, and disease; paleoepidemiology; and population anthropology. Recommended preparation: ANTH 102 or ANTH 103. Offered as ANTH 376 and ANTH 476.

ANTH 377. Human Ostology. 4 Units.
This course for upper division undergraduates and graduate students will review the following topics: human skeletal development and identification; and forensic identification (skeletal aging, sex identification and population affiliation). Offered as ANAT 377, ANTH 377, ANAT 477 and ANTH 477.

ANTH 378. Reproductive Health: An Evolutionary Perspective. 3 Units.
This course provides students with an evolutionary perspective on the factors influencing human reproductive health, including reproductive biology, ecology, and various aspects of natural human fertility. Our focus will be on variation in human reproduction in mostly non-western populations. Recommended preparation for ANTH 378: ANTH 103. Offered as ANTH 378 and ANTH 478. Counts as SAGES Departmental Seminar.

ANTH 379. Topics in Cultural and Social Anthropology. 3 Units.
Special topics of interest across the range of social and cultural anthropology. Recommended preparation: ANTH 102. Offered as ANTH 379 and ANTH 479.

ANTH 380. Independent Study in Laboratory Archaeology I. 1 - 3 Units.
This course provides an introduction to the basic methods and techniques of artifact curation and laboratory analysis in archaeology. Under the supervision of the instructor, each student will develop and carry out a focused project of material analysis and interpretation using the archaeology collections of the Cleveland Museum of Natural History. Each student is required to spend a minimum of two hours per week in the Archaeology laboratory for each credit hour taken. By the end of the course, the student will prepare a short report describing the results of their particular project. Recommended preparation: ANTH 107 and permission of department, and prior permission of Department of Archaeology at the Cleveland Museum of Natural History.

ANTH 381. Independent Study in Laboratory Archaeology II. 1 - 3 Units.
This course provides an introduction to the basic methods and techniques of artifact curation and laboratory analysis in archaeology. Under the supervision of the instructor, each student will develop and carry out a focused project of material analysis and interpretation using the archaeology collections of the Cleveland Museum of Natural History. Each student is required to spend a minimum of two hours per week in the Archaeology laboratory for each credit hour taken. By the end of the course, the student will prepare a short report describing the results of their particular project. Recommended preparation: ANTH 107 and permission of department, and prior permission of Department of Archaeology at the Cleveland Museum of Natural History.

ANTH 382. Anthropological and Ecological Perspectives on Preserving and Restoring the Natural World. 3 Units.
Now that the environmentally deleterious effects of modern Western culture on the natural world have reached major proportions it has become crucial to explore innovative solutions to this dilemma. In this course novel perspectives derived from the intersection of anthropology and ecology are discussed. The primary perspective focused upon is the understanding that human culture and the natural world in which it is embedded are essentially communicative, or semiotic processes, which thrive upon diverse interaction and feedback. Preserving and restoring the Natural World thus shifts from protecting individual species and particular cultural practices to enhancing the communicative matrix of life and multiple cultural views of the environment. Through this understanding, students will learn to apply a more elegant, effective, and aesthetically pleasing perspective to the challenging environmental issues facing our contemporary world. An in-depth examination of the North American Prairie, along with a comparison of influences on the landscape by indigenous and modern Western Culture will serve as the particular region of focus. Offered as ANTH 382 and ANTH 482. Counts as SAGES Departmental Seminar.
ANTH 388. Globalization, Development and Underdevelopment: Anthropological Perspective. 3 Units.
This course examines both theoretical and practical perspectives on globalization and economic development in the "Third World." From "Dependency," "Modernization," and "World System" theory to post-structuralist critiques of development discourse, the class seeks to provide a framework for understanding current debates on development and globalization. The "neoliberal monologue" that dominates the contemporary development enterprise is critically examined in the context of growing global inequality. Special consideration is given to the roles of international agencies such as the World Bank, International Monetary Fund, United Nations, and non-governmental organizations (NGOs) in the "development industry." The course also focuses on the contribution of anthropologists to development theory and practice with emphasis on the impact of development on the health of the poor and survival of indigenous cultures. Opportunities for professional anthropologists in the development field are reviewed. Offered as ANTH 388 and ANTH 488. Prereq: ANTH 488.

ANTH 391. Honors Tutorial. 3 Units.
Prereq: Acceptance into Honors Program.

ANTH 392. Honors Tutorial. 3 Units.
Prereq: Acceptance into Honors Program.

ANTH 396. Undergraduate Research in Evolutionary Biology. 3 Units.
Students propose and conduct guided research on an aspect of evolutionary biology. The research will be sponsored and supervised by a member of the CASE faculty or other qualified professional. A written report must be submitted to the Evolutionary Biology Steering Committee before credit is granted. Offered as ANTH 396, BIOL 396, EEPS 396, and PHIL 396. Prereq: ANTH 225 or equivalent.

ANTH 398. Anthropology SAGES Capstone. 3 Units.
Supervised original research on a topic in anthropology, culminating in a written report and a public presentation. The research project may be in the form of an independent research project, a literature review, or some other original project with anthropological significance. The project must be approved and supervised by faculty. Group research projects are acceptable, but a plan which clearly identifies the distinct and substantial role of each participant must be approved by the supervising faculty. Counts as SAGES Senior Capstone. Prereq: Major in Anthropology.

ANTH 398C. Child Policy Externship and Capstone. 3 Units.
Externships offered through CHST/ANTH/PSCL 398C give students an opportunity to work directly with professionals who design and implement policies that impact the lives of children and their families. Agencies involved are active in areas such as public health, including behavioral health, education, juvenile justice, childcare and/or child welfare. Students apply for the externships, and selected students are placed in local public or nonprofit agencies with a policy focus. Each student develops an individualized learning plan in consultation with the Childhood Studies Program faculty and the supervisor in the agency. Offered as CHST 398C, ANTH 398C, and PSCL 398C. Counts as SAGES Senior Capstone. Prereq: CHST 301.

ANTH 399. Independent Study. 1 - 6 Units.
Students may propose topics for independent reading and research.

ANTH 402. Darwinian Medicine. 3 Units.
Darwinian medicine deals with evolutionary aspects of modern human disease. It applies the concepts and methods of evolutionary biology to the question of why we are vulnerable to disease. Darwinian (or evolutionary) medicine proposes several general hypotheses about disease causation including disease as evolutionary legacy and design compromise, the result of a novel environment, a consequence of genetic adaptation, the result of infectious organisms' evolutionary adaptations, and disease symptoms as manifestation of defense mechanisms. It proposes that evolutionary ideas can explain, help to prevent and perhaps help to treat some diseases. This course presents the basic logic of Darwinian medicine and evaluates hypotheses about specific diseases that illustrate each of the hypotheses about disease causation. Recommended preparation: ANTH 103. Offered as ANTH 302 and ANTH 402.

ANTH 406. The Anthropology of Childhood and the Family. 3 Units.
Child-rearing patterns and the family as an institution, using evidence from Western and non-Western cultures. Human universals and cultural variation, the experience of childhood and recent changes in the American family. Recommended preparation: ANTH 102. Offered as ANTH 306 and ANTH 406.

ANTH 410. Introduction to Linguistic Anthropology. 3 Units.
This is an introduction to the core concepts, theories and methodologies that form the study of language from an anthropological point of view. The course provides exposure to current issues in linguistic anthropological research and reviews some of the foundational topics of research past, highlighting the contributions of linguistics to anthropology and social science. Topics to be explored include: 1) an overview of the study of language (language structure and patterns, the effects of linguistic categories on thought and behavior, meaning and linguistic relativity, cross-language comparison, and non-verbal communication); 2) doing linguistic anthropology "on the ground" (an intro to the laboratory and field techniques of linguistic anthropology); 3) the study of language as function and social action (language and social structure speech acts and events, verbal art, language and emotion); and 4) the study of language/discourse and power (language in politics, medicine, and law). Offered as ANTH 310 and ANTH 410.

ANTH 412. Ethnography of Southeast Asia. 3 Units.
This course examines the people and cultures of Southeast Asia from an anthropological perspective. From a starting place of the local people we will explore important aspects of life in this region such as agriculture, religion, health, medicine, nation-building, ethnicity, art, and technology. Additionally, we will examine and question the ideas, traditions, and scholarly modes of study that brought this geographical area together as a region. Offered as ANTH 312 and ANTH 412. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 414. Cultures of the United States. 3 Units.
This course considers the rich ethnic diversity of the U.S. from the perspective of social/cultural anthropology. Conquest, immigration, problems of conflicts and accommodation, and the character of the diverse regional and ethnic cultures are considered as are forms of racism, discrimination, and their consequences. Groups of interest include various Latina/o and Native peoples, African-American groups, and specific ethnic groups of Pacific, Mediterranean, European, Asian, and Caribbean origin. Offered as ANTH 314, ETHS 314, and ANTH 414.
ANTH 423. AIDS: Epidemiology, Biology, and Culture. 3 Units.
This course will examine the biological and cultural impact of AIDS in different societies around the world. Topics include: the origin and evolution of the virus, the evolutionary implications of the epidemic, routes of transmission, a historical comparison of AIDS to other epidemics in human history, current worldwide prevalences of AIDS, and cultural responses to the epidemic. Special emphasis will be placed on the long-term biological and social consequences of the epidemic. Recommended preparation: ANTH 102 or ANTH 103 or ANTH 105. Offered as ANTH 323 and ANTH 423.

ANTH 425. Economic Anthropology. 3 Units.
Economic anthropology is a sub-field of anthropology that examines how people in modern and non-modern societies produce, distribute, exchange, and consume goods, services, and other valued resources. The sub-field seeks to understand how cultures, including our own, organize and structure these activities through institutions, rituals, and beliefs systems. However, unlike the formal approach of the field of economics, the in-depth methods of economic anthropology concentrate on day-to-day experiences of what the economic means, how this is defined, and what we can learn about human behavior through it. This course will introduce students to economic anthropology and some of the major questions and challenges this field addresses. The history of this sub-field, how it relates to economic sociology, and areas where economic anthropology and traditional economics overlap, will also be explored. This class does not present economic anthropology and modern economics as adversaries, instead how and why they are fundamentally different orientations with often seemingly little in common. On this backdrop, this class will survey a number of different topics, including: health commodification; gift exchange; commodity chains; the history of money and debt; why objects have value; how people make ends meet; rational vs. non-rational decision-making; behavioral economic experiments conducted in other cultures; development economics, and why some objects and services have prices while others do not. Offered as ANTH 325 and ANTH 425.

ANTH 426. Power, Illness, and Inequality: The Political Economy of Health. 3 Units.
This course explores the relationship between social inequality and the distribution of health and illness across class, race, gender, sexual orientation, and national boundaries. Class readings drawn from critical anthropological approaches to the study of health emphasize the fundamental importance of power relations and economic constraints in explaining patterns of disease. The course critically examines the nature of Western biomedicine and inequality in the delivery of health services. Special consideration is given to political economic analysis of health issues in the developing world such as AIDS, hunger, reproductive health, and primary health care provision. Recommended preparation: ANTH 102 or ANTH 215. Offered as ANTH 326 and ANTH 426.

ANTH 427. Ancient Cultures of the Ohio Region. 3 Units.
This course surveys the archaeology of Native American cultures in the Great Lakes region from ca. 10,000 B.C. to A.D. 1700. The geographic scope of this course is the upper Midwest, southern Ontario, and the St. Lawrence Valley with a focus on the Ohio region. Recommended preparation: ANTH 107. Offered as ANTH 327 and ANTH 427.

ANTH 428. Medical Anthropology and Public Health. 3 Units.
Anthropology has a longstanding relationship with the field of public health, which dates back to before the flourishing of medical anthropology as a subfield. Direct participation of medical anthropologists in public health research and practice continues to grow. This course explores the intersection of medical anthropology and public health from the perspective of anthropological history, theory, and methods. Course topics include: the history of anthropological work in public health, medical anthropology theory as a guide to anthropological public health research, and anthropological methods and approaches to public health work. Case studies from around the world will be employed throughout the course. Offered as ANTH 328 and ANTH 428.

ANTH 429. Anthropological Perspectives of Migration and Health. 3 Units.
This course provides an overview of anthropological perspectives on transnational migration and health. We will focus particularly on health and health care issues concerning refugees, asylum seekers and undocumented migrants. This course will focus on the following topics: the physical and mental health consequences of forced migration; refugee trauma; the intersection of health care and immigration policies; immigration and health care access and utilization. Readings and coursework will consider the sociocultural, political, and economic factors that contribute to migrant health disparities. We will also address issues of medical pluralism among transnational migrants and critically examine the concept of cultural competence in clinical settings. Class readings will comprise a variety of theoretical and ethnographic literature within anthropology and closely related disciplines, drawing on cases from across the globe and in cross-cultural comparison. The class will use lectures, readings, and class discussions to explore these relevant issues in migration and health, with the opportunity to engage in hands on ethnographic work with refugees locally. Offered as ANTH 329 and ANTH 429.

ANTH 435. Illegal Drugs and Society. 3 Units.
This course provides perspectives on illegal drug use informed by the social, political and economic dimensions of the issues. Framed by the history, epidemiology, and medical consequences of drug use, students will confront the complex challenges posed by addiction. Anthropological research conducted in the U.S. and cross-culturally will demonstrate, elaborate and juxtapose various clinical, public health, and law enforcement policies and perspectives. Topics examined will include: why exclusively using a bio-medical model of addiction is inadequate; how effective is the war on drugs; what prevention, intervention and treatment efforts work; and various ideological/moral perspectives on illegal drug use. Offered as ANTH 335 and ANTH 435.

ANTH 437. Comparative Medical Systems. 3 Units.
This course considers the world’s major medical systems. Foci include professional and folk medical systems of Asia and South Asia, North and South America, Europe and the Mediterranean, including the Christian and Islamic medical traditions. Attention is paid to medical origins and the relationship of popular to professional medicines. The examination of each medical tradition includes consideration of its psychological medicine and system of medical ethics. Recommended preparation: ANTH 215. Offered as ANTH 337 and ANTH 437.
ANTH 438. Maternal Health: Anthropological Perspectives on Reproductive Practices and Health Policy. 3 Units.
The reproductive process is shared by humans as biological beings. However, the experience of pregnancy and childbirth is also dependent on the cultural, social, political, historical, and political-economic setting. This course frames issues in reproductive health by looking at the complex issues associated with maternal health and mortality worldwide. After reviewing biomedical perspectives on reproductive processes this course will focus on childbirth and pregnancy as the process and ritual by which societies welcome new members. This course will review ethnomedical concepts; discuss the interaction between local, national, and global agendas shaping reproductive practices; and conclude with anthropological critiques of reproductive health initiatives. Offered as ANTH 338 and ANTH 438.

ANTH 439. Ethnographic and Qualitative Research Methods. 3 Units.
This is a course on applying ethnographic research methods in the social sciences. Ethnographic research seeks to understand and describe the experiences of research participants (i.e. subjects) through becoming involved in their daily lives. Findings from ethnography are generated through systematic observation within the natural context in which behavior occurs (i.e. fieldwork). Unlike methods that emphasize detachment, distance, and objectivity, ethnography involves developing knowledge by becoming an ad hoc member of the group(s) one is studying. The principal techniques of ethnography, "participant-observation" and "in-depth open ended interviewing," require actively engaging the research process. This class will explore ethnographic research techniques, as well as other qualitative research methods. In addition to addressing how such methods make claims about social phenomena, this class will also explore more practical topics such as: developing questions, entering the field, establishing rapport, taking and managing field notes, coding data, and data analysis. Lectures, readings, and class discussion will be complemented by assignments using techniques. Offered as ANTH 339 and ANTH 439.

ANTH 447. Cultural Ecology: An Epistemological Approach to Environmental Sustainability. 3 Units.
This course provides the understanding that the realm of human culture is where both the cause and cure of nearly all contemporary environmental sustainability challenges are found. This is because culture is the medium through which humans as living systems perceive, interpret, and act upon their environment. Through understanding principles that guide living systems and applying them to human/nature interaction in diverse cultures throughout the world, students develop an ecological epistemology, or way of knowing nature. This leads to more effective advocacy for environmental sustainability and an increasing depth in interaction with nature, particularly in the domains of aesthetics and the sacred. Offered as ANTH 347 and ANTH 447. Counts as SAGES Departmental Seminar.

ANTH 449. Cultures of Latin America. 3 Units.
The aim of this course is to consider cultural diversity and social inequality in contemporary Latin America from an anthropological perspective. A variety of aspects related to ethnicity, religion, music, gender, social movements, cuisine, urban spaces, violence, and ecology are considered in addition to current economic and political issues. These topics will be analyzed in relation to Latin America's complex historical and social formation and its identity representations. The course takes under consideration various case studies in which not just local communities but also perceptions of national institutions and practices will be analyzed from pluralistic approaches (provided by either Latin American and non-Latin American researchers) that combine fieldwork, interviews and life experiences with textual and media sources. Special attention will be paid to contemporary global issues affecting Latin America. Offered as ANTH 349 and ANTH 449. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 450. Culture, Science and Identity. 3 Units.
This course in the Cultural Studies of Science focuses on the ways in which social identities are constructed and imagined in contemporary and historical sciences and medicines. In particular, the course will consider gender, ethnic, "racial," class and age identities as these are (re)constructed over time in medical and natural scientific discourses across professional cultures. Attention is paid to the means by which notions of normality and abnormality and category specificity are created and altered to and the dynamics of discursive formations. The course also considers the social and medical consequences of specific constructions of biology in general and with respect to specific identities and social classifications. Offered as ANTH 350 and ANTH 450.

ANTH 453. Chinese Culture and Society. 3 Units.
Focuses on Chinese cultural and social institutions during the Maoist and post-Maoist eras. Topics include ideology, economics, politics, religion, family life, and popular culture. Recommended preparation: ANTH 102. Offered as ANTH 353 and ANTH 453. Counts for CAS Global & Cultural Diversity Requirement.

ANTH 454. Health and Healing in East Asia. 3 Units.
This course examines the illness experiences and the healing practices in East Asia. After introducing the anthropological approaches to the study of medicine, this course will explore the practices of ethnomedicine and biomedicine, mental health, family planning and reproductive health, the experience of aging and care giving, infectious disease, environmental health, and biotechnology. By delving into the illness experiences and the healing practices in East Asia, the course will discuss issues related to medical pluralism, health inequality, biological citizenship, social stigmatization, and bioethics. Offered as ANTH 354 and ANTH 454. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate Standing.

ANTH 459. Introduction to International Health. 3 Units.
Critical health problems and needs in developing countries. Prevalence of infectious disease, malnutrition, chronic disease, injury control. Examines strategies for improvement of health in less developed countries. Recommended preparation: ANTH 102. Offered as ANTH 359 and ANTH 459.
ANTH 460. Global Politics of Fertility, Family Planning, and Population Control. 3 Units.
This course offers an anthropological examination of fertility behaviors around the world. In particular, it explores various historical, cultural, socioeconomic, political, and technological factors contributing to reproductive activities. After introducing the anthropological approaches to the study of fertility, the course will delve into the ways to regulate fertility in historical and contemporary times, various factors contributing to fertility change, state intervention in reproduction through voluntary and coercive family planning programs, and new reproductive technologies and ethical concerns surrounding assisted reproduction and abortion. Offered as ANTH 360, ANTH 460 and WGST 360. Prereq: Graduate Standing.

ANTH 461. Urban Health. 3 Units.
This course provides an anthropological perspective on the most important health problems facing urban population around the world. Special attention will be given to an examination of disparities in health among urban residents based on poverty, race/ethnicity, gender, and nationality. Offered as ANTH 361 and ANTH 461.

ANTH 462. Contemporary Theory in Anthropology. 3 Units.
A critical examination of anthropological thought in England, France and the United States during the second half of the twentieth century. Emphasis will be on the way authors formulate questions that motivate anthropological discourse, on the way central concepts are formulated and applied and on the controversies and debates that result. Readings are drawn from influential texts by prominent contemporary anthropologists. Recommended preparation: ANTH 102. Offered as ANTH 362 and ANTH 462.

ANTH 465. Gender and Sex Differences: Cross-cultural Perspective. 3 Units.
Gender roles and sex differences throughout the life cycle considered from a cross-cultural perspective. Major approaches to explaining sex roles discussed in light of information from both Western and non-Western cultures. Offered as ANTH 365, ANTH 465 and WGST 365.

ANTH 466. Population Change: Problems and Solutions. 3 Units.
The course examines population processes and their social consequences from an anthropological perspective. It introduces basic concepts and theories of population studies and demonstrates the ways in which anthropological research contributes to our understanding of population issues. We will explore questions such as: How has world population changed in history? How does a population age or grow younger? What are the factors affecting population health? Why do people migrate? And what are the policy implications of population change? We will examine the sociocultural, economic, political, and ecological factors contributing to population processes, such as factors affecting childbearing decisions, cultural context of sex-selective abortion, various caregiving arrangements for the elderly, and policy responses to population change. We will explore these issues with cases from across the world, with a special focus on China, the world’s most populous country with the most massive family-planning program in modern human history. Offered as ANTH 366 and ANTH 466. Prereq: Graduate standing.

ANTH 467. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANTH 367, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467.

ANTH 471. Culture, Behavior, and Person: Psychological Anthropology. 3 Units.
Cross-cultural perspectives on personality, human development, individual variability, cognition, deviant behavior, and the role of the individual in his/her society. Classic and contemporary anthropological writings on Western and non-Western societies. Recommended preparation: ANTH 102. Offered as ANTH 371 and ANTH 471.

ANTH 472. Anthropological Approaches to Religion. 3 Units.
The development of, and current approaches to, comparative religion from an anthropological perspective. Topics include witchcraft, ritual, myth, healing, religious language and symbolism, religion and gender, religious experience, the nature of the sacred, religion and social change, altered states of consciousness, and evil. Using material from a wide range of world cultures, critical assessment is made of conventional distinctions such as those between rational/irrational, natural/supernatural, magic/religion, and primitive/civilized. Recommended preparation: ANTH 102. Offered as ANTH 372, RLGN 372 and ANTH 472.

ANTH 475. Human Evolution: The Fossil Evidence. 3 Units.
This course will survey the biological and behavioral changes that occurred in the hominid lineage during the past five million years. In addition to a thorough review of the fossil evidence for human evolution, students will develop the theoretical framework in evolutionary biology. Recommended preparation: ANTH 377, BIOL 225. Offered as ANAT 375, ANTH 375, ANTH 475 and ANTH 475. Prereq: ANTH 103.

ANTH 476. Topics in the Anthropology of Health and Medicine. 3 Units.
Special topics of interest, such as the role of human adaptability; the ecology of the human life cycle health delivery systems; transcultural psychiatry; nutrition, health, and disease; paleoepidemiology; and population anthropology. Recommended preparation: ANTH 102 or ANTH 103. Offered as ANTH 376 and ANTH 476.

ANTH 477. Human Osteology. 4 Units.
This course for upper division undergraduates and graduate students will review the following topics: human skeletal development and identification; and forensic identification (skeletal aging, sex identification and population affiliation). Offered as ANAT 377, ANTH 377, ANTH 377 and ANTH 477.

ANTH 478. Reproductive Health: An Evolutionary Perspective. 3 Units.
This course provides students with an evolutionary perspective on the factors influencing human reproductive health, including reproductive biology, ecology, and various aspects of natural human fertility. Our focus will be on variation in human reproduction in mostly non-western populations. Recommended preparation for ANTH 378: ANTH 103. Offered as ANTH 378 and ANTH 478. Counts as SAGES Departmental Seminar.

ANTH 479. Topics in Cultural and Social Anthropology. 3 Units.
Special topics of interest across the range of social and cultural anthropology. Recommended preparation: ANTH 102. Offered as ANTH 379 and ANTH 479.
ANTH 480. Medical Anthropology and Global Health I. 3 Units.
The first in a sequence of two graduate core courses in medical anthropology and global health. This course focuses on foundational concepts and theories in medical anthropology, as well as topical areas which have been central to the development of the field. Prereq: Graduate Standing in Anthropology.

ANTH 481. Medical Anthropology and Global Health II. 3 Units.
The second in a sequence of two graduate core courses in medical anthropology and global health. This course focuses on the application of medical anthropology theory and methods to the study of global health. Recommended preparation: ANTH 480. Prereq: Graduate Standing in Anthropology.

ANTH 482. Anthropological and Ecological Perspectives on Preserving and Restoring the Natural World. 3 Units.
Now that the environmentally deleterious effects of modern Western culture on the natural world have reached major proportions it has become crucial to explore innovative solutions to this dilemma. In this course novel perspectives derived from the intersection of anthropology and ecology are discussed. The primary perspective focused upon is the understanding that human culture and the natural world in which it is embedded are essentially communicative, or semiotic processes, which thrive upon diverse interaction and feedback. Preserving and restoring the Natural World thus shifts from protecting individual species and particular cultural practices to enhancing the communicative matrix of life and multiple cultural views of the environment. Through this understanding, students will learn to apply a more elegant, effective, and aesthetically pleasing perspective to the challenging environmental issues facing our contemporary world. An in-depth examination of the North American Prairie, along with a comparison of influences on the landscape by indigenous and modern Western Culture will serve as the particular region of focus. Offered as ANTH 382 and ANTH 482. Counts as SAGES Departmental Seminar.

ANTH 488. Globalization, Development and Underdevelopment: Anthropological Perspective. 3 Units.
This course examines both theoretical and practical perspectives on globalization and economic development in the "Third World." From "Dependency," "Modernization," and "World System" theory to post-structuralist critiques of development discourse, the class seeks to provide a framework for understanding current debates on development and globalization. The "neoliberal monologue" that dominates the contemporary development enterprise is critically examined in the context of growing global inequality. Special consideration is given to the roles of international agencies such as the World Bank, International Monetary Fund, United Nations, and non-governmental organizations (NGOs) in the "development industry." The course also focuses on the role of anthropologists to development theory and practice with emphasis on the impact of development on the health of the poor and survival of indigenous cultures. Opportunities for professional anthropologists in the development field are reviewed. Offered as ANTH 388 and ANTH 488.

ANTH 495. Research Practicum in Medical Anthropology and Global Health. 3 Units.
This course prepares selected Anthropology graduate students for research in medical anthropology and global health in both local and global settings, with the goal of enhancing the research skills of students early in their graduate careers. Prereq: Graduate standing in Anthropology.

ANTH 501. Seminar in Anthropology and Global Health: Topics. 3 Units.
The objective of the course is to provide graduate students in medical anthropology an in-depth examination of global health from several perspectives. The course will feature perspectives from anthropologists as well as others working in the fields of global health. Prereq: Graduate standing in Anthropology.

ANTH 503. Seminar in Social Cultural Anthropology. 3 Units.

ANTH 504. Anthropological Research Design. 3 Units.
Practical and theoretical issues in the selection of questions for health and aging research in societal settings. Illustration of frameworks and designs for research. Discussion of the problems of collection, analysis, and interpretation of data along with the nonscientific influences on the research process and the use of results. Prereq: Graduate standing in anthropology.

ANTH 511. Seminar in Anthropology and Global Health: Topics. 3 Units.
This course examines the current issues in global health and the emerging anthropological paradigm directed at global health issues. The objective of the course is to provide graduate students in medical anthropology an in-depth examination of global health from several perspectives. The course will feature perspectives from anthropologists as well as others working in the fields of global health. Prereq: Graduate standing in Anthropology.

ANTH 513. Seminar in Ethnopsychiatry. 3 Units.
Theory and practice of psychotherapeutic forms. Diagnostic and therapeutic forms from Europe, the United States, Japan, India, and other major cultural traditions and those of local areas such as West Africa, Native America, and Latin America. The cultural theories of mental disorders, related conceptions of self and person, and the relationships of local psychological theory to clinical practice and outcome.

ANTH 519. Seminar in Human Ecology and Adaptability. 3 Units.

ANTH 520. Seminar in Medical Anthropology: Topics. 3 Units.
Various topics will be offered for graduate students in medical anthropology, such as "Anthropological Perspectives on Women's Health and Reproduction" and "Biocultural Anthropology." Prereq: ANTH 480.

(Credit as arranged.) Advanced studies in anthropology.

ANTH 601. Independent Research. 1 - 18 Units.
(Credit as arranged.)

ANTH 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Art History and Art

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www.case.edu/arts/arth/arth.html
Phone: 216.368.4118 or 368.2383; Fax: 216.368.4681
Catherine Scallen, Department Chair
catherine.scallen@case.edu

The Department of Art History and Art (http://www.case.edu/artsci/arth/arth.html) offers opportunities to study art history, to engage in pre-professional museum training, to participate in a broad range of studio offerings, and to pursue state teacher licensure in art education. The Bachelor of Arts degree is granted in art history and in pre-architecture (second major only), and the Bachelor of Science degree in art education. The department offers graduate programs leading to the degrees of Doctor of Philosophy in art history, Master of Arts in art history, Master of Arts in art history and museum studies, and Master of Arts in art education. In conjunction with the School of Law, the department also offers a combined JD/Master of Arts in art history and museum studies. Qualified undergraduates majoring in art history or art education may participate in the Integrated Graduate Studies Program.
All art programs are considerably enhanced by close cooperation with cultural institutions located in University Circle, in particular the Cleveland Museum of Art, the Cleveland Institute of Art, and the Museum of Contemporary Art (MOCA). The newly founded Nancy and Joseph Keihley Institute for Art History, created jointly with the Cleveland Museum of Art, will promote art historical studies through graduate fellowship support, collections-based graduate seminars, travel and research funding, undergraduate internship funding, and joint programming with the Cleveland Museum of Art.

**Art History Program**

Students majoring in art history have a wide variety of career opportunities. Graduates with a strong background in art history are employed as college and university professors; as museum professionals (in curatorial, educational, and administrative positions); as art librarians and archivists; as development officers; as journalists; as art gallery or auction house staff members; as art conservators and restorers; as art specialists in the diplomatic service and at all levels of government; and in other careers in industry, film, and television. Some of these specialties require additional study and professional preparation beyond the bachelor's degree. Other art history majors who have fulfilled the required prerequisites go on to attend law, medical, or business school.

The graduate programs in art history are offered as part of the joint program in art history of Case Western Reserve University and the Cleveland Museum of Art. Most classes, undergraduate and graduate level, are held in the museum, and some courses are offered or co-taught by museum curators who hold adjunct appointments in the department. Students taking advanced-level courses use the museum's extensive research library, and all students have an opportunity to study original works of art in the museum's superb collections.

**Art Education Program**

The Art Education Program's mission is "to prepare proactive, scholar-practitioner art educators who will develop into leaders, teachers, and talented artists in the field of art education."

The undergraduate and graduate degree programs in art education are offered in conjunction with the Cleveland Institute of Art. Art education majors have the advantage of pursuing their academic studies in a university environment and their studio studies at a professional art school that educates artists and designers. Students participate in educational field experiences conducted in many of Greater Cleveland's urban and suburban school systems, museums, and cultural institutions. Graduates of the Art Education Program have pursued careers as teachers, supervisors, and consultants in public and private schools, colleges, art schools, and museums; as administrators of galleries and art organizations; as designers of educational programs for industry; and as practicing artists. The program is especially proud of its record in recruiting and graduating students from diverse backgrounds.

**Art Studio Program**

For students seeking to develop and nurture their artistic and creative talents, the Art Studio Program offers a variety of introductory art courses that can be taken for personal enjoyment to gain experience in a variety of art media. Courses in drawing, painting, design, ceramics, enameling and jewelry, textiles, photography, digital media, and architecture are taught at various skill levels by experienced, professional artists/teachers. These courses can be taken as university electives or to fulfill minors in art studio, photography, or architecture. The program offers pre-architecture as a second major and as a minor for students who expect to continue architectural studies at the graduate level or who simply wish to pursue an area of interest to complete a second major in pre-architecture. At the end of each semester, there is a comprehensive public art exhibition of student work in the Art Gallery.

**Undergraduate Programs**

The art history curriculum is designed to give students a broad grounding in a variety of artistic media with a strong emphasis on understanding the cultural context in which they were produced. Students develop technical and critical vocabularies as well as sound writing skills to analyze works of art. Study of and research on works of art in the Cleveland Museum of Art is an essential component of the undergraduate curriculum. Internships for credit or with volunteer status are available at the Cleveland Museum of Art, the Museum of Contemporary Art, and other arts institutions in University Circle.

**Integrated Graduate Studies Program.** Qualified undergraduates majoring in art history or art education may also participate in the Integrated Graduate Studies Program (p. 1078). Interested students should note the general requirements and the admission procedures in this bulletin and may consult the department for further information. The GRE is required for all students applying to the IGS program in art history.

**Majors**

**Bachelor of Arts in Art History**

This major requires 36 hours of course work in art history, including:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ARTH 101</td>
<td>Art History I: Pyramids to Pagodas</td>
<td>3</td>
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<tr>
<td>ARTH 102</td>
<td>Art History II: Michelangelo to Maya Lin</td>
<td>3</td>
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<tr>
<td>Art History 200-level courses</td>
<td></td>
<td>3-6</td>
</tr>
<tr>
<td>ARTH 396</td>
<td>Majors Seminar</td>
<td>3</td>
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<tr>
<td>Art History electives at the 300 level</td>
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<td>15-18</td>
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<tr>
<td>Art Studio courses</td>
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<td>3-6</td>
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Foreign language study (French, German, or Italian) is highly recommended.

**Departmental Honors.** Majors who wish to earn the Bachelor of Arts degree with honors in art history must make written application to the department chair no later than the fall semester of their senior year. Departmental honors are awarded upon fulfillment of the following requirements: a grade point average of at least 3.5 in the major and an A in ARTH 399 Honors Thesis.

**Bachelor of Science in Art Education**

The Bachelor of Science in art education requires a total of 124 credits and is designed to educate professional teachers of art for public and private schools who are also competent, creative artists. The program meets the requirements of the Ohio Board of Education to qualify its university-recommended students for Pre-K-12 Visual Art Specialist Licensure to teach art in the public schools of Ohio and more than 40 reciprocating states.

This program is conducted jointly by Case Western Reserve University and the Cleveland Institute of Art. Admission requires application to Case Western Reserve and submission of an art portfolio to the Cleveland Institute of Art. Credentials must be acceptable to both institutions. Academic work is taken at Case Western Reserve, and the majority of art studio courses at the Cleveland Institute of Art, as follows:
Academic Courses at Case Western Reserve University

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>SAGES (First Seminar)</td>
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<td>4</td>
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<tr>
<td>Two of the following:</td>
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<tr>
<td>USNA Thinking About Natural and Technological World</td>
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<td>USSO Thinking about the Social World</td>
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<tr>
<td>USSY Thinking about the Symbolic World</td>
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<tr>
<td>Natural Sciences</td>
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<tr>
<td>Quantitative Reasoning (MATH or STAT)</td>
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<td>3</td>
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<tr>
<td>Global &amp; Cultural Diversity</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>ARTH 101</td>
<td>Art History I: Pyramids to Pagodas</td>
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<tr>
<td>ARTH 102</td>
<td>Art History II: Michelangelo to Maya Lin</td>
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<tr>
<td>ARTH Electives (one must be at 300 level)</td>
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<td>6</td>
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<tr>
<td>PHED Physical Education (2 semesters)</td>
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Total Units: 31

Professional Education/Art Education

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ARTS 295</td>
<td>Introduction to Art Education</td>
<td></td>
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<tr>
<td>ARTS 300</td>
<td>Current Issues in Art Education</td>
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<tr>
<td>ARTS 385</td>
<td>Clinical/Field Based Experience I</td>
<td></td>
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<tr>
<td>ARTS 386</td>
<td>Clinical/Field Based Experience II</td>
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<tr>
<td>ARTS 387</td>
<td>Clinical/Field Based Experience III</td>
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</tr>
<tr>
<td>ARTS 393</td>
<td>Art Content, Pedagogy, Methodology, and Assessment</td>
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<tr>
<td>ARTS 366A</td>
<td>Student Teaching in Art: Pre-K - 6th Grade</td>
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<tr>
<td>ARTS 366B</td>
<td>Student Teaching in Art: 7th - 12th Grade</td>
<td></td>
</tr>
<tr>
<td>ARTS 465</td>
<td>Seminar for Art Teachers</td>
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<tr>
<td>EDUC 301</td>
<td>Introduction to Education</td>
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<tr>
<td>PSCL 101</td>
<td>General Psychology I</td>
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<tr>
<td>EDUC 304</td>
<td>Educational Psychology</td>
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<tr>
<td>EDUC 255</td>
<td>Literacy Across the Content Areas</td>
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<tr>
<td>EDUC 386</td>
<td>Introduction to Instructional Technology</td>
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Total Units: 39

Art Studio Courses at the Cleveland Institute of Art

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Art and Design</td>
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<tr>
<td>Design 2D and 3D</td>
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<td>6</td>
</tr>
<tr>
<td>Drawing I, II, III</td>
<td></td>
<td>9</td>
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<tr>
<td>Painting ARTS 216 and CIA Color</td>
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<td>6</td>
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<tr>
<td>2D Visualization</td>
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<td>3</td>
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<tr>
<td>Studio Project</td>
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<td>3</td>
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<tr>
<td>Sculpture</td>
<td></td>
<td>3</td>
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<tr>
<td>Studio Electives</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

Total Units: 51

Retention and Advanced Standing (Undergraduate Level)

The Bachelor of Science program in art education is designed to educate professional teachers of art. There are four decision points in the program, and for each of these decision points, there are three possible outcomes: unconditional admission; conditional admission with a prescribed remedial plan which when successfully completed will result in unconditional admission; or denial of admission. Denial of admission at any decision point means the student is no longer able to pursue an art education degree at Case Western Reserve.

**Decision Point 1: Entry to the Program**

Official admission to the Art Education Program generally occurs at the end of the fall semester of the sophomore year after a student completes ARTS 295 Introduction to Art Education. Admission to the program requires:

1. Successful interview and satisfactory score on the Teacher Licensure Admission Assessment
2. Cumulative GPA at CWRU of 2.7 or better (undergraduate)
3. Demonstration of entry-level competency in the discipline through successful presentation of an art portfolio
4. Signed statement of Good Moral Character
5. Being accepted as an art major through a portfolio review before matriculation
6. Successful completion of ARTS 295 Introduction to Art Education, including evaluation of an initial Teaching ePortfolio

**Decision Point 2: Admission to Advanced Standing**

The Application for Advanced Standing should be submitted by the junior year and the fall semester after Decision Point 1. The application requires:

1. Cumulative GPA of 2.7 or better
2. Discipline GPA of 2.7 or better
3. Education GPA of 3.0 or better
4. Minimum average score of 2.0 on Candidate Disposition Assessment Inventory (DAI)
5. Minimum average score of 2.0 on the ePortfolio

**Decision Point 3: Admission to Student Teaching**

The Application for Student Teaching should be completed by week 8 of the semester prior to student teaching. The application requires:

1. Cumulative GPA of 2.7 or better
2. Discipline GPA of 2.7 or better
3. Education GPA of 3.0 or better
4. Minimum average score of 2.5 on the ePortfolio that includes documentation of clinical/field experiences
5. Pass TB test; present documentation of hepatitis B vaccinations
6. Pass criminal background checks (BCI & FBI)
7. Minimum average score of 2.5 on Candidate Disposition Assessment Inventory
8. Successful completion of the Student Teaching Interview

**Decision Point 4: Retention During the Student Teaching Semester**

1. Minimum average score of 2.75 on each CWRU Student Teaching Final Assessment by Cooperating Teacher and University Supervisor during the first student teaching placement
2. Minimum average mid-semester score of 2.75 on DAI

**Decision Point 5: Recommendation for Initial Licensure**

1. Cumulative GPA of 2.7 or better
2. Discipline GPA of 2.7 or better
3. Education GPA of 3.0 or better
4. Completion of degree requirements
5. Minimum average score of 3.0 on the ePortfolio
6. Minimum average score of 3.0 or better on Candidate Disposition Assessment Inventory

7. Completion of CWRU Student Teaching Final Assessment by Cooperating Teacher and University Supervisor averaging 3.0 or better on each

8. Achieve passing scores on Ohio licensure exams

9. Completion of the following: Feedback on University Supervisor, Feedback on Cooperating Teacher, CWRU Teacher Licensure Exit Interview and Survey

After successfully completing all requirements at the four decision points, the student is recommended by the university's director of teacher education for the Ohio Visual Art (Pre-K-12) License. Completion of the Bachelor of Science in art education does not ensure that the State of Ohio's Visual Art Teacher License will be awarded.

Teacher licensure is also obtainable through the Art Education Graduate Program of Study. Additional information on this program is available in the office of the director of art education.

**Bachelor of Arts in Pre-Architecture**

The Pre-Architecture Program introduces the student to the forms, history, and functions of architecture as well as to the studio skills relevant to its practice. The program is designed to provide a background for undergraduate students who plan to continue architectural studies at the graduate level, as well as for those interested in the study of architecture as part of a liberal or technical education.

Pre-architecture may be chosen only as a second major. The double major is required so that the perspectives provided by this interdisciplinary program may be complemented by a concentrated disciplinary experience. For a student who completes a Bachelor of Science degree (BS, BSE, or BSN), pre-architecture may serve as the sole major for a BA degree.

To declare a pre-architecture major, students should have declared a first major and have sophomore or junior standing. Up to 6 credits in general education requirements and elective courses taken by students for their first major may be applied to their pre-architecture major.

The major consists of a minimum of 30 credit hours, 15 of which are required courses and the remainder of which are approved elective courses. Detailed information about approved electives is available in the departmental office.

The required courses are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTH 101</td>
<td>Art History I: Pyramids to Pagodas</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 102</td>
<td>Art History II: Michelangelo to Maya Lin</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 106</td>
<td>Creative Drawing I</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 302</td>
<td>Architecture and City Design I</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 303</td>
<td>Architecture and City Design II</td>
<td>3</td>
</tr>
<tr>
<td>Art history courses</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Two of the following:</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>ARTS 101</td>
<td>Design and Color I</td>
<td></td>
</tr>
<tr>
<td>ARTS 201</td>
<td>Design and Color II</td>
<td></td>
</tr>
<tr>
<td>ARTS 206</td>
<td>Creative Drawing II</td>
<td></td>
</tr>
<tr>
<td>ARTS 220</td>
<td>Photography Studio I</td>
<td></td>
</tr>
<tr>
<td>ARTS 304</td>
<td>Architecture and City Design III</td>
<td></td>
</tr>
<tr>
<td>THTR 223</td>
<td>Scenic Design</td>
<td></td>
</tr>
<tr>
<td>THTR 224</td>
<td>Lighting Design</td>
<td></td>
</tr>
<tr>
<td>One of the following:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td></td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td></td>
</tr>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td></td>
</tr>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
<td></td>
</tr>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td></td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units**  

30

* For students whose interests lie in aesthetics and the history of architecture, the required 3 hours may be in sociology, American studies, anthropology, history (specifically courses on the history of science and technology), civil engineering, or earth, environmental, and planetary sciences.

**Program Minors**

Four minors, each requiring 18 credit hours, are available: one in art history, and three through the Art Studio Program: Art Studio, Photography, Pre-Architecture.

**Art History**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTH 101</td>
<td>Art History I: Pyramids to Pagodas</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 102</td>
<td>Art History II: Michelangelo to Maya Lin</td>
<td>3</td>
</tr>
<tr>
<td>Art History electives (at least 3 hours must be taken at the 200 level)</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units**  

18

**Art Studio**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTS 101</td>
<td>Design and Color I</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 106</td>
<td>Creative Drawing I</td>
<td>3</td>
</tr>
<tr>
<td>Four additional studio courses, two of which must be in the same area (i.e., drawing, painting, design, textiles, photography, ceramics and enameling)</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units**  

18

**Photography**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTS 220</td>
<td>Photography Studio I</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 320</td>
<td>Photography Studio II</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 322</td>
<td>Digital Photography I</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 325</td>
<td>Creative Photography</td>
<td>3</td>
</tr>
<tr>
<td>or ARTS 365D</td>
<td>B&amp;W Photography Studio</td>
<td></td>
</tr>
<tr>
<td>ARTS 365E</td>
<td>Color Studio</td>
<td>3</td>
</tr>
<tr>
<td>One of the following:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ARTS 399</td>
<td>Independent Study in Art Studio</td>
<td></td>
</tr>
<tr>
<td>ARTH 102</td>
<td>Art History II: Michelangelo to Maya Lin</td>
<td></td>
</tr>
<tr>
<td>ARTS 323</td>
<td>Creative Digital Photography II</td>
<td></td>
</tr>
<tr>
<td>ARTS 350</td>
<td>Multimedia I</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units**  

18
Doctoral students must demonstrate an ability to read two approved languages other than English useful in art historical research. The general examination cannot be taken until the language requirement is fulfilled either through course work or successfully passing language reading examinations.

Doctoral students are required to pass an oral examination of major and minor fields and a written examination in the form of a research paper of 20-30 pages in length. The topic for the research paper will be set by the examination committee after the oral examination is held; the paper will be due two weeks after the student picks up the assigned topic. A final evaluation will be based on the student's performance in both the written and oral sections of the general examination.

**Master of Arts in Art History**

The MA program in art history is designed to provide the student with a broad knowledge of the major art historical periods, scholarly and bibliographical resources, and the methodologies of art history. It also offers an opportunity to investigate art historical problems in some depth. In addition to the regular graduate school application form, applicants to the graduate program in art history are required to submit GRE scores and copies of two research papers that they consider to represent their best work. Applicants for the MA should have a BA major or minor concentration in art history or a related humanities field and a minimum GPA of 3.5. All applicants whose native language is not English, or who have not received a degree from an English-speaking university, must take the Test of English as a Foreign Language (TOEFL); the required minimum score on the online test is 100.

The master's degree in art history is conducted exclusively under Plan B as described under the School of Graduate Studies (p. 1045) in this bulletin. All other requirements of the MA program must be fulfilled:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTH 495</td>
<td>Methodologies of Art History</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 496</td>
<td>Materials, Methods, and Physical Examination of Works of Art</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 610A</td>
<td>Advanced Visual Arts and Museums: Internship I</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 610B</td>
<td>Advanced Visual Arts and Museums: Internship II</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 701</td>
<td>Dissertation Ph.D.</td>
<td>18</td>
</tr>
</tbody>
</table>

Total Units: 30

**Master of Arts in Art History and Museum Studies**

The MA program in art history and museum studies includes the same broad requirements and objectives of the MA program in art history, along with a year-long museum studies course and two supervised museum internships. In addition to the regular graduate school application form, applicants to the graduate program in art history are required to submit GRE scores and copies of two research papers that they consider to represent their best work. Applicants for the MA should have a BA major or minor concentration in art history or a related humanities field and a minimum GPA of 3.5. All applicants whose native language is not English, or who have not received a degree from an English-speaking university, must take the Test of English as a Foreign Language (TOEFL); the required minimum score on the online test is 100.

The requirements include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTH 495</td>
<td>Methodologies of Art History</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 490A</td>
<td>Visual Arts and Museums</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 490B</td>
<td>Visual Arts and Museums Internship</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 491A</td>
<td>Visual Arts and Museums: Internship</td>
<td>1</td>
</tr>
<tr>
<td>ARTH 491B</td>
<td>Visual Arts and Museums: Internship</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units: 30
Six graduate courses at the 400 level or above, three of which must be seminars on the 500 level. These six courses must include one course each from four of the following five areas: world art, ancient, medieval, Renaissance/Baroque and modern/American. A reading knowledge of one foreign language (normally French, German, or Italian). Successful performance on the MA comprehensive examination. Total Units 31

**JD/MA in Art History and Museum Studies**

The School of Law at Case Western Reserve University prepares JD students to practice law in, among other areas, the fields of intellectual property and law and the arts. The MA in Art History and Museum Studies program, coordinated by the Department of Art History and Art and the Cleveland Museum of Art, is designed to provide students with a broad knowledge of the major art historical periods, of the historiography and critical methodologies of art history, and of museological practice and history, connoisseurship, conservation, and interpretation, through course work and museum internships. The dual degree program prepares students to participate in the fields of intellectual property and law and the visual arts and provides students with an opportunity to develop expertise in areas of substantive interest.

The School of Law requires 88 credit hours of coursework, including 36 hours of required courses and an upper-class writing requirement, for the JD degree. Most of the requirements are completed during the first year of the law program, which includes:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAWS 1201</td>
<td>Civil Procedure</td>
<td>4</td>
</tr>
<tr>
<td>LAWS 1101</td>
<td>Contracts</td>
<td>4</td>
</tr>
<tr>
<td>LAWS 1102</td>
<td>Criminal Law</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 1103</td>
<td>Torts</td>
<td>4</td>
</tr>
<tr>
<td>LAWS 1204</td>
<td>Law, Legislation and Regulation</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 1203</td>
<td>Property</td>
<td>4</td>
</tr>
<tr>
<td>LAWS 1801</td>
<td>Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 1</td>
<td>4</td>
</tr>
<tr>
<td>LAWS 1802</td>
<td>Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 2</td>
<td>4</td>
</tr>
</tbody>
</table>

In addition to the 30 credits of first-year courses, JD students must complete LAWS 2001 Professional Responsibility, LAWS 2002 Constitutional Law I, and LAWS 2803 Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 3: Advanced Skills during their second year of study. Students must also fulfill an upper-class writing requirement and complete a capstone project during the final year of study. Students should consult the School of Law curriculum guides for details about degree requirements that are applicable to the JD/MA dual degree program.

Students in the MA program in art history and museum studies must complete 31 hours of graduate credit, nine hours of which must be taken in the Law School, to satisfy the requirements for the dual JD/MA degree. In addition, students in the MA program must demonstrate a reading knowledge of one approved modern language other than English. They must also take the MA comprehensive examination at the conclusion of their art history studies.

The 31 hours of coursework must be taken at the 400 level or higher, and be distributed as follows:

- **ARTH 490A** Visual Arts and Museums I 3
- **ARTH 490B** Visual Arts and Museums II 3
- **ARTH 491A** Visual Arts and Museums: Internship 1
- **ARTH 491B** Visual Arts and Museums: Internship 3
- **ARTH 495** Methodologies of Art History 3

One course in each of the following areas:

- Pre-Modern (pre-1800)
- Modern (post-1800)
- Other

* Three of the courses in these two categories must be seminars.

The dual degree program requires students to complete 98 credit hours. Law students enrolled in the dual degree program will earn up to 12 credit hours toward the JD degree for completion of the graduate-level art history courses. Credit will not be given for work done in such courses before the student completes the first year of law school. Dual degree students are required to complete 22 credit hours toward the MA. Nine hours of law school coursework will count toward the 31 hours required for the MA in Art History and Museum Studies. The Department of Art History and Art liaison must approve the law school courses that will count toward the MA.

Dual degree students generally begin study in the law school and defer enrollment in the MA program until their second year. (There may be exceptions to this general rule. In certain cases, for example, students may be permitted to take one course in the art history department during the second semester of the first year of law school.) Students interested in completing the dual degree should consult both programs early in the process to avoid difficulties. After the first year of law school, students may enroll in law courses or art history courses; the program will not require students to complete a specific “core” in a “dedicated” semester in the Department of Art History and Art. Completion of the dual degree program will take at least seven semesters, or three-and-a-half years of coursework.

Year 1: First-year law school curriculum. (30 hours)

Year 2, 3 & 4: Mixture of courses between the two units, including 22 hours of coursework in the art history program and the MA comprehensive examination.

Credit Hour Requirements

- Total Hours in the School of Law: 76
- Total Hours in the art history department: 22
- Total Hours in the Dual Degree Program: 98

**Dual Degree Student Advising System**

Dual degree students are advised by the Associate Dean for Academic Affairs at the School of Law. In addition, dual degree students are granted priority registration for upperclass courses, ensuring that they will be able
to enroll in the classes they need. In the Department of Art History and Art, dual degree students will be advised by the art history department liaison and the director of graduate studies.

Admissions

Students wishing to enroll in the dual degree program must be separately admitted to each program. The Department of Art History and Art will waive the GRE requirement for admission to the MA program and use the LSAT in the admissions process. Applicants can apply to the dual degree program when they apply to the School of Law or after the first year of enrollment in the School of Law. Once students have been admitted, they will consult with the Associate Dean for Academic Affairs at the School of Law and the Department of Art History and Art liaison to determine their appropriate course of study.

Master of Arts in Art Education

The Master of Arts in Art Education is offered in two plans: Plan I for those who already hold teacher licenses and who desire advanced studio- and art-related studies; Plan II for those holding the Bachelor of Fine Arts or equivalent degree who desire multi-age teacher licensure as visual art specialists. Both programs are offered jointly by Case Western Reserve University and the Cleveland Institute of Art, and both require 36 semester hours.

The admission procedure includes an online application, three letters of recommendation, a college transcript, which are to be submitted to the Art Education office, and an interview with the program director in which students show a portfolio of artwork and discuss their program of study. For students pursuing Plan I, the Cleveland Institute of Art admission procedure requires a portfolio. Approval by both the University and the Cleveland Institute of Art is required for admission into Plan I. Information and application forms are available online through the Office of Graduate Admission at Case Western Reserve University.

Plan I

- 18 hours in studio to be taken at the Cleveland Institute of Art or Case Western Reserve University at the 300 level or above; and 18 hours in academic courses to be taken at Case Western Reserve University at the 400 level or above, to be selected in consultation with the director of art education; or
- 30 semester hours of course credit: 18 hours in studio to be taken at the Cleveland Institute of Art at the 300 level or above; and 12 hours in academic courses to be taken at Case Western Reserve University at the 400 level or above, to be selected in consultation with the director of art education; AND a required Thesis Exhibition based on individual research (not less than 6 semester hours of registration).

Plan II

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 401</td>
<td>Introduction to Education</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 404</td>
<td>Educational Psychology</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 486</td>
<td>Introduction to Instructional Technology</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 385</td>
<td>Clinical/Field Based Experience I</td>
<td>1</td>
</tr>
<tr>
<td>ARTS 386</td>
<td>Clinical/Field Based Experience II</td>
<td>1</td>
</tr>
<tr>
<td>ARTS 387</td>
<td>Clinical/Field Based Experience III</td>
<td>1</td>
</tr>
<tr>
<td>ARTS 400</td>
<td>Current Issues in Art Education</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 493</td>
<td>Art Content, Pedagogy, Methodology, and Assessment</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 466A</td>
<td>Student Teaching in Art: Pre-K - 6th Grade</td>
<td>4</td>
</tr>
</tbody>
</table>

The Master’s Plan II Program in Art Education is designed to educate professional teachers of art. There are four decision points in the Art Education Program. For each of the decision points, there are three possible outcomes: unconditional admission; conditional admission with a prescribed remedial plan which when successfully completed will result in unconditional admission; or denial of admission. Denial of admission at any decision point means the student is no longer able to pursue an art education degree at Case Western Reserve University.

Decision Point 1: Entry to the Program

Application for admission to the program requires:
1. being accepted to the university
2. being accepted as an art major through an art portfolio review
3. submission of a signed Statement of Assurance of Good Moral Character
4. a satisfactory interview with art education faculty, documented on the Teacher Licensure Admission Assessment Form

Decision Point 2 and 3: Admission to Advanced Standing & Student Teaching

Application for advanced standing and student teaching requires:
1. Cumulative GPA of 2.7 or better
2. Discipline GPA of 2.7 or better
3. Education GPA of 3.0 or better
4. Minimum average score of 2.5 on the ePortfolio
5. Pass TB test; present documentation of hepatitis B vaccinations
6. Pass criminal background checks (BCI & FBI)
7. Minimum average score of 2.5 on Candidate Disposition Assessment Inventory
8. Successful completion of the Student Teaching Interview.

Decision Point 4: Retention During the Student Teaching Semester

1. Minimum average score of 2.75 on each CWRU Student Teaching Final Assessment by Cooperating Teacher and University Supervisor during the first student teaching placement
2. Minimum average mid-semester score of 2.75 on DAI

Decision Point 5: Recommendation for Initial Licensure

Application for initial licensure occurs after successful completion of all degree requirements. The application requires:
1. Cumulative GPA of 2.7 or better.
2. Discipline GPA of 2.7 or better.
3. Education GPA of 3.0 or better
4. Completion of degree requirements
5. Minimum average score of 3.0 on the ePortfolio
6. Minimum average score of 3.0 or better on Candidate Disposition Assessment Inventory

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTS 465</td>
<td>Seminar for Art Teachers</td>
<td>4</td>
</tr>
<tr>
<td>ARTS 602</td>
<td>Study in Art Education</td>
<td>3</td>
</tr>
<tr>
<td>ARTS 497</td>
<td>Summer Workshop in Art Education</td>
<td>3</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>36</td>
</tr>
</tbody>
</table>
7. Completion of CWRU Final Student Teaching Assessment by Cooperating Teacher and University Supervisor averaging 3.0 or better on each.
8. Achieve passing scores on Ohio Licensure exams.
9. Completion of the following: Feedback on University Supervisor, Feedback on Cooperating Teacher, CWRU Teacher Licensure Exit Interview and Survey.
10. Submission of a current final transcript documenting the following: a cumulative GPA of 3.0 or better, an art course GPA of 3.0 or better, and an education GPA of 3.0 or better.
11. A passing score on the Candidate Disposition Assessment Inventory, completed by the art education faculty.
12. Achievement of state-mandated scores on the two Ohio Assessments for Educators exams.
13. Completion of the Case Student Teaching Final Assessment by the cooperating teacher and university supervisor with a grade of B or better.
14. Completion of the Case Teacher Licensure Exit Interview and Survey.

After successfully completing all requirements at the four decision points, the student is recommended by the university’s director of teacher education for the Ohio Provisional Art (Pre-K-12) License. Completion of the Master’s Plan II Program in Art Education degree does not ensure that the State of Ohio’s Provisional Visual Art Teacher License will be awarded.

**Department Faculty**

Henry Adams, PhD  
(Yale University)  
*Ruth Coulter Heede Professor of Art History*  
American art

Erin Benay, PhD  
(Rutgers University)  
*Climo Junior Professor; Assistant Professor*  
Early Modern Southern European Art

Elina Gertsman, PhD  
(Boston University)  
*Professor*  
European medieval art

Noelle Giuffrida, PhD  
(University of Kansas)  
*Assistant Professor*  
Asian art

Maggie L. Popkin, PhD  
(The Institute of Fine Arts, New York University)  
*Robson Junior Professor; Assistant Professor*  
Ancient Roman art and archaeology

Andrea Wolk Rager, PhD  
(Yale University)  
*Jesse Hauk Shera Assistant Professor*  
Nineteenth- and twentieth-century British and European art

Catherine B. Scallen, PhD  
(Princeton University)  
*Andrew W. Mellon Professor in the Humanities; Associate Professor*  
Northern Renaissance and Baroque art and historiography

**Secondary Faculty**

Miriam R. Levin, PhD  
(University of Massachusetts)  
*Henry Eldridge Bourne Professor of History, Department of History*

**Adjunct Faculty from the Cleveland Museum of Art**

Louis Adrean, MLS  
(Syracuse University)  
*Adjunct Instructor*  
Library Instruction

Michael Bennett, PhD  
(Harvard University)  
*Adjunct Professor; Curator, Greek and Roman Art*

Susan Bergh, PhD  
(Columbia University)  
*Adjunct Associate Professor; Curator, Art of the Ancient Americas*

Cory Korkow, PhD  
(University of Virginia)  
*Adjunct Associate Professor; Associate Curator, European Art, Cleveland Museum of Art*

Heather Lemonedes, PhD  
(The Graduate School and University Center, City University of New York)  
*Adjunct Associate Professor; Chief Curator*

Sooa Im McCormick, PhD  
(University of Kansas)  
*Adjunct Assistant Professor; Assistant Curator of Korean Art*

Sonya Quintanilla, PhD  
(Harvard University)  
*Adjunct Professor; George P. Bickford Curator of Indian and Southeast Asian Art, Cleveland Museum of Art*

William Robinson, PhD  
(Case Western Reserve University)  
*Adjunct Professor; Curator, Modern European Art*

Barbara Tannenbaum, PhD  
(University of Michigan)  
*Adjunct Professor; Curator of Photography*

Sinéad Vilbar, PhD  
(Princeton University)  
*Adjunct Professor; Curator, Japanese Art, Cleveland Museum of Art*

**Art Education**

Tim Shuckerow, MA  
(Case Western Reserve University)  
*Director, Art Education and Art Studio Program*  
Art Education, Painting, Ceramics
Adjunct Art History Faculty

Heather Galloway, Certificate in Conservation; MA in Art History
(Conservation Center, Institute of Fine Arts, New York University; Williams College Graduate Program in the History of Art)
Adjunct Assistant Professor
Physical Examination of Works of Art

Gary Sampson, PhD
(University of California, Santa Barbara)
Associate Dean, Graduate Studies, Cleveland Institute of Art
History of photography

Holly Witchey, PhD
(Case Western Reserve University)
Adjunct Professor
Museum studies

Emeriti

Walter S. Gibson
Andrew W. Mellon Professor Emeritus of the Humanities

Ellen G. Landau
Andrew W. Mellon Professor Emerita of the Humanities

Edward J. Olszewski
Professor Emeritus

ARTH Courses

ARTH 101. Art History I: Pyramids to Pagodas. 3 Units.
The first half of a two-semester survey of world art highlighting the major monuments of the ancient Mediterranean, medieval Europe, MesoAmerica, Africa, and Asia. Special emphasis on visual analysis, and socio-cultural contexts, and objects in the Cleveland Museum of Art. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 102. Art History II: Michelangelo to Maya Lin. 3 Units.
The second half of a two-semester survey of world art highlighting the major monuments of art made in Africa, the Americas, Asia, and Europe from 1400 to the present. Special emphasis on visual analysis, historical and sociocultural contexts, and objects in the Cleveland Museum of Art. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 203. The Arts of Asia. 3 Units.
This course surveys a selection of major developments in the arts of Asia from the bronze age to the present in a wide range of media including: sculpture, painting, ceramics, architecture, bronzes, calligraphy, prints and contemporary installations. We explore factors behind the making of works of art, including social, political, religious and personal meanings, while examining the historical contexts for the arts of India, China, Japan, Korea, Cambodia and Thailand. Attention will be paid to the material and stylistic qualities of art as well as art's relationship to the ideas and practices of Buddhism, Hinduism, and Daoism. Visits to the Asian galleries at the Cleveland Museum of Art form an integral part of the course. Counts for CAS Global & Cultural Diversity Requirement.
ARTH 208. Arts of Japan. 3 Units.
This course explores a selection of major developments in Japanese visual and material culture from ancient times to the present day. We consider works in multiple media including paintings, sculpture, calligraphy, ceramics, woodblock prints, architecture, performance art, and installations. We look into the roles of art in society, the relationship of art to political authority, the place of art in religious practice and experience, connections between art and literature, and how art relates to the expression of personal, social, political, and cultural identity. We pay particular attention to tea ceramics, Edo and Meiji period, woodblock prints, Chinese and Euro-American influences on Japanese art, works associated with Buddhist religious practices and ideas such as folk painting, portraiture, and statuary connected with Zen. We also examine the role of museums in selecting, preserving, and presenting Japanese art in the 20th and 21st century. Visits to the Cleveland Museum of Art form an integral part of the course. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 220. Jewish Traditional Art and Architecture. 3 Units.
Tradition and transformation in Jewish artistic expression over time and across space. Course will begin with biblical period and continue down to the present day in Israel and America. Examination of how concepts such as "Jewish" and "art" undergo change within the Jewish community over this period. Offered as ARTH 220 and JDST 220. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 221. Building on Antiquity. 3 Units.
Beginning with Ancient Greece and Rome and ending in Cleveland, the course will provide orientation in the architectural orders and in most periods of European and Euro-American architectural history, as well as to an extent, architectural criticism. The issue of how architecture has meaning will be central, not least in connection with the formalized "language" of classicism and the emergence of development of building types (temple, museum, civic hall, transportation buildings, etc.). We will also review more subtle ways in which architecture conveys meaning or mood, and the assignment of gendered associations to certain architectural elements. The course will consider more or less blatant political uses of architecture and architectural imagery, but also more elusive and/or ambiguous cases, as well as the phenomenon of the shifting meanings of architecture through changes of era, owner, audience, etc. Offered as ARTH 221 and CLSC 221.

ARTH 226. Greek and Roman Sculpture. 3 Units.
This survey course explores the history of sculpture in ancient Greece and Rome, from the Mycenaean period through the reign of Constantine (A.D. 306-337). Students learn how to analyze works of art and architecture in terms of form, function, and iconography. Particular emphasis is placed on situating objects and monuments within the changing historical, cultural, political, and religious contexts of ancient Rome, including major changes such as the shift from the Roman Republic to the Roman Empire and the advent of Christianity. Students will study a variety of media—such as statues, painting, metalwork, and domestic and public architecture—from the city of Rome itself as well as Roman provinces as far afield as Asia Minor and North Africa. The course will introduce students to famous buildings such as the Colosseum and the Pantheon but also to lesser known but equally important works. As we study major objects and monuments from ancient Rome, we will consider questions of design, patronage, artistic agency, viewer reception, and cultural identity. We will also consider Rome's complex relationship to Greek culture and attempt to answer the question of what makes Roman art distinctively "Roman." Offered as ARTH 230 and CLSC 230. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 240. Ancient Roman Art and Architecture. 3 Units.
This survey course explores the history of Roman art and architecture from Rome's founding in 753 B.C. up through the reign of Constantine (A.D. 306-337). Students learn how to analyze works of art and architecture in terms of form, function, and iconography. Particular emphasis is placed on situating objects and monuments within the changing historical, cultural, political, and religious contexts of ancient Rome, including major changes such as the shift from the Roman Republic to the Roman Empire and the advent of Christianity. Students will study a variety of media--such as statues, painting, metalwork, and domestic and public architecture--from the city of Rome itself as well as Roman provinces as far afield as Asia Minor and North Africa. The course will introduce students to famous buildings such as the Colosseum and the Pantheon but also to lesser known but equally important works. As we study major objects and monuments from ancient Rome, we will consider questions of design, patronage, artistic agency, viewer reception, and cultural identity. We will also consider Rome's complex relationship to Greek culture and attempt to answer the question of what makes Roman art distinctively "Roman." Offered as ARTH 230 and CLSC 230. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 241. Medieval Art. 3 Units.
This course will introduce students to the pivotal works of art created between approximately 250 and 1500. We will discuss painting, sculpture, architecture, manuscript illumination, and graphic arts. Medieval visual and material culture will be considered within the framework of socio-political developments, rapid urban growth, the flowering of monastic culture, the rise of universities, and changes in devotional practices. While the course will primarily focus on western part of the medieval Christendom, we will also discuss Jewish, Byzantine, and Islamic art. Visits to the CMA will form an integral part of the course. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 249. The Global Middle Ages: From Paris to Baghdad. 3 Units.
This reading-intensive course will explore the ways in which medieval thought was manifested in Christian and Islamic art, and discusses parallels, divergences, and convergences between the two visual cultures. Topics will include, but will not be limited to, medieval attitudes towards the body as manifested in illuminated manuscripts; art as a tool for religious and a vehicle for devotion; illustrations in herbals and medical books; advances in architecture; literary themes translated into visual art; art created by and for women, and the image as an instrument for political thought and propaganda. While Christian and Islamic visual cultures are traditionally studied separately, this course will examine medieval culture as a whole, thereby providing the students with a distinctive educational experience. Offered as ARTH 249 and HSTY 249. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 250. Art in the Age of Discovery. 3 Units.
A survey of developments in Renaissance art and architecture in northern Europe and Italy during a new age of science, discovery and exploration, 1400-1600.

ARTH 260. Art in Early Modern Europe. 3 Units.
A survey of European art in the seventeenth and eighteenth centuries, an era of rising nationalism, political aggrandizement, religious expansion and extravagant art patronage. The tensions between naturalism and idealization, court and city, public and private, church and secular patronage, grand commissions and an open air market, will provide themes of the course as we explore what characterized the arts of Austria, Belgium, England, France, Germany, Italy, The Netherlands, and Spain. Counts for CAS Global & Cultural Diversity Requirement.
ARTH 270. American Art and Culture Before 1900. 3 Units.
Survey of the development of American art from colonial times to the present which explores how art has expressed both American values and American anxieties. Painting is emphasized, but the course also considers architecture, the decorative arts, film, literature, and music. Offered as AMST 270 and ARTH 270.

ARTH 271. American Art and Culture: The Twentieth Century. 3 Units.
Survey of the development of American art from 1900 to the present (and the future) which will explore how art has expressed both American values and American anxieties. Painting will be emphasized, but the course will also consider architecture, the decorative arts, film, literature, and music. Offered as AMST 271 and ARTH 271.

ARTH 274. Nineteenth-Century European Art. 3 Units.
This course will examine the development of European art across the tumultuous long nineteenth century, from the French Revolution in 1789 to the eve of the First World War in 1914. Adopting a thematic, as well as an international approach, this course will seek to interrogate the canonical understanding of this period of dramatic change across France, Britain, Germany, and Spain. We will explore issues of politics, economics, class, gender, imperialism, nationalism, and industrialization that surround the advent of artistic modernity. The class will also consider a range of artistic media, including painting, sculpture, photography, the decorative arts, and architecture, taking advantage of the rich collections of the Cleveland Museum of Art. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 280. Modern Art and Modern Science. 3 Units.
An examination of the development of painting, sculpture, and architecture from the 19th to the mid 20th century. Special attention is given to the emergence of "modernism" and the influence of science on such movements as Impressionism and Cubism.

ARTH 284. History of Photography. 3 Units.
A survey of the history of photography from its inception in 1839 to the present. Emphasis is on the complex relationship between technological innovations and picture-making; the artistic, documentary, and personal uses of photography; and the relationship of photography to other art forms.

ARTH 301. Museums and Globalization. 3 Units.
Museums are everywhere contested spaces today. Historically designed as symbols of power, centers for research, agents of public education and community formation in Western industrial societies, they have become sites of development and cultural controversy on a global scale. From Cleveland and Paris to Nairobi and Dubai museums figure in urban redevelopment, national identity formation, conflicts between religion and science, and global tourism. Questions we will consider in this course: what are the fundamental features of museums as institutions? what ties have linked them to wider national and international communities of academics, NGO's and business? to political, economic and social concerns? how do museums in Asia, Africa, the Middle East, and Latin America figure in the current international contention over heritage rights? This is an innovative course allowing students to collaborate on projects, engage with guest lecturers and access museums across the globe. The course is organized in three parts: Part I: National Identity Building and Museums; Part II: Museums and Identity Politics; Part III: Museums and Global Development. Offered as HSTY 329, ARTH 301, HSTY 429, and ARTH 401. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 302. Buddhist Art in Asia. 3 Units.
This course explores the visual and material culture of Buddhism in Asia from its origins in India to its transmission and transformation in China, Korea, Japan, Tibet, Thailand, Cambodia and Indonesia. Our historically and culturally structured examination traces major developments in Buddhist art and their relationships with belief, practice, and ritual. We consider the ways that artistic traditions have adapted and evolved both within individual cultures and cross-culturally. We primarily focus on studying the historical contexts for sculpture, architecture, and painting, but we also consider the movement of Buddhist works from temples to sites of secular display in museums around the world, and the religious, cultural, and ethical issues that arise from these moves. Topics include: representations of the life of the historical Buddha; visual programs of temples; artistic representations of paradises and hells; sacred sites and architecture; imperial patronage of Buddhist art; the role of art in pilgrimage and ritual; and visual imagery associated with Pure Land, Chan, Zen and esoteric traditions. Visits to and engagement with objects in the new Asian galleries at the Cleveland Museum of Art provide a rich environment for our class sessions and student projects. Offered as ARTH 302 and ARTH 402. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 307. Arts of China. 3 Units.
This course explores a selection of major developments in Chinese visual and material culture from ancient times to the present day. We consider works in multiple media including bronzes, pottery, sculpture, calligraphy, paintings, ceramics and installations. We look into the roles of art in society, the relationship of art to political authority, the place of art in religious practice and experience, connections between art and literature, and how art relates to the expression of personal, social, political, and cultural identity. We pay particular attention to landscape painting; pictorial and sculptural programs of Buddhist grottoes; art commissioned and collected by the imperial court; objects associated with Daoist, Buddhist, and Confucian religious practices and sacred sites; art produced during periods of non-Chinese rule under the Mongols and Manchus; the affects of foreign styles and ideas on artists; and the role of Chinese artists in the contemporary global art world and market. We also examine the role of museums in selecting, preserving, and presenting Chinese art in the 20th and 21st century. Visits to the Cleveland Museum of Art form an integral part of the course. Offered as ARTH 307 and ARTH 407. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 308. Daoism: Visual Culture, History and Practice. 3 Units.
This course explores developments in the visual culture, history and practices of Daoist religious traditions in China from the third to twentieth centuries. Our historically and conceptually structured examination draws upon a balance of visual, textual, and material sources, while considering the various approaches scholars have employed to understand the history and development of Daoist traditions. Topics include: sacred scriptures and liturgies, biographies and visual narratives, iconography and functions of the pantheon of gods and immortals, views of the self and the body, practices of inner alchemy and self-cultivation, thunder deities and exorcism, dietetics and medicine and modes of meditation and ritual. Offered as ARTH 308, ARTH 408, and RLGN 308. Counts for CAS Global & Cultural Diversity Requirement.
ARTH 311. Rome: City and Image. 3 Units.
This course studies the architectural and urban history of Rome from the republican era of the ancient city up to the eighteenth century using the city itself as the major “text.” The emphasis will be placed on the extraordinary transformations wrought in the city, or at least in key districts, by powerful rulers and/or elites, especially in the ancient empire and in the Renaissance and baroque eras. In a larger perspective, the great construction projects exerted a far-reaching effect within and beyond Europe, but we will study them in relation to their topographical situation, their functions, and their place in a long history of variations on prestigious themes since many of the artworks and the urban settings featured in the course carry the mark of the Long history of the city itself. Recommended preparation: At least one 200-level course in ANTH, ARTH, CLSC, ENGL, HSTY, or RLGN. Offered as ARTH 311, ARTH 411, and CLSC 311. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 325. Art at the Crossroads of Religion: Polytheistic, Christian, and Islamic Art in Antiquity. 3 Units.
People often single out the reign of Constantine (A.D. 306-337) as the point in history when Rome transformed from a polytheistic empire to a Christian empire. This course questions the strict divide between the categories of “pagan” and “Christian” in Rome in the imperial period and beyond. Through a close examination of the artistic and architectural record, students will come to understand that this dichotomy is a modern invention; for people living in the Roman Empire, religious identities were extraordinarily fluid. Indeed, traditional polytheistic religion and Christianity remained closely intertwined for centuries after Constantine “Christianized” the Empire. Moreover, religious pluralism had been a fundamental part of Roman culture since the founding of ancient Rome. We will survey a range of material culture, including public statuary, sarcophagi, silver hordes, and temples and churches. We will also examine sites such as the border city of Dura-Europos in Syria to explore how religious identities in the Roman Empire (including Judaism, early Christianity, and so-called mystery cults) intertwined even when Rome was still supposedly a “pagan” Empire. The course pays particular attention to the art and architecture produced under Constantine, whom people today often remember as Rome’s first Christian emperor but who represents, in fact, a complex amalgam of polytheistic and monotheistic practices and identities. We will also explore how Christian art slowly but ultimately became the predominant visual culture in the Roman Empire. Finally, we will examine how Early Islamic art and architecture exploited the Greco-Roman visual tradition to the ends of this new religion. Offered as ARTH 325, ARTH 425 and CLSC 325. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 329. Marvels of Rome: Monuments and Their Decoration in the Roman Empire. 3 Units.
This course examines some of the most famous monuments of the Roman Empire, including Nero’s Golden House, the Colosseum, the Pantheon, Hadrian’s Villa at Tivoli, and the lavish villa of Piazza Armerina in Sicily. We will study each monument in depth, delving into the architecture, paintings, sculptures, mosaics, and social functions of each monument. Students will learn how to analyze artistic and archaeological evidence, ancient textual evidence (poems, prose, and inscriptions), and secondary scholarship to reconstruct the visual appearances and historical and cultural contexts of the monuments in questions. Throughout the course, students will gain a new appreciation and deeper understanding of some of the most iconic buildings of the classical tradition. Offered as ARTH 329, ARTH 429, and CLSC 329. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 332. Art and Archaeology of Ancient Italy. 3 Units.
The arts of the Italian peninsula from the 8th century B.C. to the 4th century A.D., with emphasis on recent archaeological discoveries. Lectures deal with architecture, sculpture, painting, and the decorative arts, supplemented by gallery tours at the Cleveland Museum of Art. Offered as ARTH 332, CLSC 332, and ARTH 432.

ARTH 333. Greek and Roman Painting. 3 Units.
Greek vase painting, Etruscan tomb painting and Roman wall painting. The development of monumental painting in antiquity. Offered as ARTH 333, CLSC 333, and ARTH 433.

ARTH 334. Art and Archaeology of Greece. 3 Units.
A survey of the art and architecture of Greece from the beginning of the Bronze Age (3000 B.C.) to the Roman conquest (100 B.C.) with emphasis on recent archaeological discoveries. Lectures deal with architecture, sculpture, painting, and the decorative arts, supplemented by gallery tours at the Cleveland Museum of Art. Offered as ARTH 334, CLSC 334, and ARTH 434.

ARTH 335. Issues in Ancient Art. 3 Units.
Various topics in Ancient art. Lectures, discussions and reports. Offered as ARTH 335 and ARTH 435.
ARTH 336. Representations of War in Ancient Rome. 3 Units.
Few societies in history have been as militaristic as ancient Rome--or as proud of their warrior culture. This course examines the many ways that Romans constructed and contested their conceptions of war from the founding of the Roman Republic in 509 B.C.E. to the reign of Constantine (306-337 C.E.). Why did Romans choose to represent war in certain ways, and how did these artistic representations shape Romans' military values? What can the visual record tell us about how different groups (soldiers, women, slaves) experienced war in the Roman world? We will explore major public monuments in the city of Rome (including triumphal arches and the Colosseum) and private objects (such as silver drinking vessels) to observe how Roman militarism pervaded different walks of life. We will also examine monuments on the edges of Rome's empire, such as the towering trophies in modern France and Romania, to explore how works of art and architecture mediated the relationship between Romans and the peoples they conquered. Students will be encouraged to think about how art and architecture contributed to the construction of militarism as a chief Roman value, but also about how visual representations provided an important means to debate the value of Rome's military efforts, to subvert Rome's rigidly hierarchical social order, and to grapple with what it meant to "be Roman" as wars transformed Rome from a small city in Italy to a massive, pan-Mediterranean empire. After exploring Romans' conceptions of war and victory, students also may ask whether the common comparison between the Roman Empire and modern America is appropriate. Offered as ARTH 336, ARTH 436 and CLSC 336. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 340. Issues in the Art of China. 3 Units.
This is a topics course. Each offering will focus on a specific topic within the area of Chinese art. Sample topics may include: Women painters in Beijing, Modern Artists in China-1980-Present, Shang Dynasty Tombs, Yuan Dynasty Buddhist Art. Lectures, discussions, and reports. Offered as ARTH 340 and ARTH 440.

ARTH 341. Issues in the Art of Japan. 3 Units.
This is a topics course. Each offering will focus on a specific topic within the area of Japanese art. Sample topics may include: Muromachi Hanging Scrolls, Ryoan-ji Temple Garden Architecture, Rimpa School Panel Screens, Buddhist Painting in the Edo Period. Lectures, discussions, and reports. Offered as ARTH 341 and ARTH 441.

ARTH 342. Issues in Indian and Southeast Asian Art. 3 Units.
This course covers topics in the history of India and neighboring regions with emphasis on connections with works in the Cleveland Museum of Art. Offerings include The Buddha Image, Murals and Manuscripts, The Hindu Temple, Krishna in Art and Literature, and the History of Mughal Painting. Lectures, discussions, and reports. Offered as ARTH 342, ARTH 442, and HSTY 324. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 349. Gothic Art: Vision and Matter. 3 Units.
This course will examine the development and dissemination of Gothic art in Western Europe in the High and Late Middle Ages. We will consider a variety of media, including architecture, metalwork, sculpture, manuscript illumination, panel paintings, fresco cycles, and small devotional objects. As we study medieval art in its socio-historical contexts--private and public, monastic and political, liturgical and lay--we will pay special attention to issues of patronage, relationships between texts and images, the introduction of visionary and mystical devotion, attitudes towards education and authority, differences between male and female piety, modes of medieval viewing, and reception and manipulation of art by medieval audiences. Visits to the CMA will form an integral part of the course. Offered as ARTH 349 and ARTH 449. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 350. Issues in Medieval Art. 3 Units.
Various topics in Medieval Art. Lectures, discussions, and reports. Offered as ARTH 350 and ARTH 450.

ARTH 352. Italian Art of the 15th Century. 3 Units.
The early 15th century in Florence, civic humanism, the sculpture of Ghiberti and Donatello, the painting of Masaccio; the International Style in painting, the art of Uccello, Piero della Francesca, Mantegna, and Botticelli; Carpaccio and the Bellini in Venice. Offered as ARTH 352 and ARTH 452.

ARTH 353. Sixteenth Century Italian Art. 3 Units.
The development of the High Renaissance and Mannerist styles in Italy and late 16th century trends: painting and sculpture. Offered as ARTH 353 and ARTH 453.

ARTH 355. The Book in the Middle Ages: The Christian, Jewish, and Islamic Tradition. 3 Units.
This course will examine later medieval manuscript production, paying particular attention to the issues of patronage, gender, literacy, reception, and cultural biases. We will explore the imagery and texts of monastic and courtly manuscripts, travel books and devotional manuals, all within the framework of the tightly interwoven theological and social discourses of the institutions that commissioned them. As the title of the course indicates, we will study Christian, Jewish, and Islamic books and their interrelations; for example, we will compare Islamic encyclopedias of the natural world, such as Zakariya ibn Muhammad al-Qazwini's illustrated Wonders of Creation, with medieval bestiaries, herbs, and encyclopedias such as Hartman Schedel's Liber Chronicarum and Les Merveilles du Monde. Each religious culture will receive a special close-study spotlight: Jewish Haggadot (books for the Passover Seder), Christian courtly romances, and Islamic manuscripts of the Shahnama epic. Offered as ARTH 355 and ARTH 455. Counts for CAS Global & Cultural Diversity Requirement.
ARTH 357. Medieval Wonders: Monuments from Across the Globe. 3 Units.
This course will introduce art of the medieval world, considered globally, with a special focus on monuments surviving from the seventh to fifteenth centuries. Emphasis will be on sculpture and architecture; other media—manuscript illumination, wall paintings, ceramics, and metalwork—will be discussed in conjunction with the related sites. We will travel, virtually, to Pre-Columbian Yucatan, Judeo-Christian Europe, Islamic Spain and Central Asia, Hindu and Buddhist India, Tibet, and Southeast Asia. Each week one or two monuments will be discussed in depth, and other sites will be introduced to place it into historical and art historical contexts. Among the themes we will explore are the power relationships between sovereignty and religion; visual expressions of politics and propaganda; the ways literature, performance, and devotion informed medieval material culture; the importance of pilgrimage; and influences of international trade. Ethical and nationalist issues surrounding looting and cultural patrimony will also be discussed. Objects from CMA’s permanent collections will form an integral part of the course. Each unit will end with the consideration of collecting practices. Offered as ARTH 357 and ARTH 457.

ARTH 358. Medieval Body. 3 Units.
This course will explore the meanings and representations of the body in western medieval culture. Topics will include bleeding bodies, fragmented bodies, lactating bodies, labile bodies, cosmic bodies, physiological bodies, mystical bodies, suffering bodies, edible bodies, enclosed bodies, gendered bodies, Christ’s bodies, Mary’s bodies, decomposing bodies, macabre bodies, resurrected bodies, dead bodies, intercessory bodies, unhinging bodies, translucent bodies, martyred bodies, desirable bodies, abhorrent bodies, mnemonic bodies, mimetic bodies, nude bodies, marginalized bodies, defleshed bodies, social bodies, political bodies, monstrous bodies, mnemonic bodies, and deformed bodies. We will explore the complex rhetoric of embodiment as it manifests itself in the ambiguous discourse—both medieval and contemporary—on the relationships between the material and intangible, spiritual and physical, somatic and mental, corporeal and ethereal. Offered as ARTH 358 and ARTH 458. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 359. Visual Culture of Medieval Women. 3 Units.
This course will consider the roles of women as patrons, subjects, producers and consumers of visual culture, focusing particularly on the twelfth through fifteenth centuries. Throughout the course, we will study the different ways medieval men and women perceived, read, figured, and interacted with the female body, which was frequently seen as a fraught site of desire and repulsion, fear and fascination. Students will be asked to read primary sources as well as critical materials that address contradictory constructions of gender and sex in medieval images and texts. The course, therefore, will not simply focus on artistic production, but will include readings and discussions of social and political history, theology, and literature of the Middle Ages. Offered as ARTH 359 and ARTH 459; cross-listed as WGST 359 since it focuses on the role of women in visual culture and so can satisfy a requirement in the program for the course on women in the arts. Offered as ARTH 359, ARTH 459 and WGST 359. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 360. Renaissance Art in Northern Europe. 3 Units.
Painting, sculpture, and the graphic arts in Belgium, France, Germany, and The Netherlands, 1400-1580, highlighting the careers and contributions of specific artists such as Jan van Eyck, Albrecht Durer, and Pieter Bruegel. We will also analyze the changing social, cultural, religious, and political circumstances of the art made during this period, which saw the invention of printmaking, the Protestant Revolution, and increased strife between rulers and their subjects. The rise of new subjects such as landscape and scene of everyday life will be explored, and changes in patronage will be discussed, concentrating on the shift from church and noble patronage to increasingly middle-class patronage related to the beginnings of the open art market. Offered as ARTH 360 and ARTH 460. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 361. 17th-Century Art in Belgium and The Netherlands. 3 Units.
The arts of painting, drawing, and printmaking in Belgium and The Netherlands are discussed in relationship to political, social, cultural, and religious contexts. We will explore the careers and production of individual artists such as Rubens, Van Dyck, Hals, Rembrandt, and Vermeer. Developments in new subjects, artistic specialization, and the expansion of the open market are seen as important factors in shaping Belgian and Dutch art. Offered as ARTH 361 and ARTH 461. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 362. Issues in Early Modern Southern European Art. 3 Units.
Various topics in the art of southern Europe, 1400-1800. Lectures, discussions, reports, and gallery visits in the CMA. Offered as ARTH 362 and ARTH 462. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 365. Issues in Early Modern Northern European Art. 3 Units.
Various topics in the art of northern Europe, 1400-1800. Lectures, discussions, reports, and gallery visits in the CMA. Offered as ARTH 365 and ARTH 465. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 374. Impressionism to Symbolism. 3 Units.
Major developments in European painting and sculpture during the latter half of the nineteenth century. Post-impressionism synthetism, symbolism, and the arts and crafts movement considered in their socio-cultural contexts. Works of Degas, Manet, Monet, Klimt, Bocklin, Gauguin, etc. Offered as ARTH 374 and ARTH 474.

ARTH 379. Issues in 19th Century Art. 3 Units.
Various topics in 19th century art, with class lectures, discussions and reports. Consult department for current topic. Offered as ARTH 379 and ARTH 479.

ARTH 380. Abstract Expressionism and Its Aftermath. 3 Units.
An examination of the development and influences of Abstract Expressionism, including the impact on the Beat Generation and Pop Art. Offered as ARTH 380 and ARTH 480.
ARTH 382. Art, Eco-criticism, and the Environment. 3 Units.  
As issues of sustainability and environmental impact have become increasingly dominant concerns in contemporary society, eco-criticism has emerged as a vital methodological thread across the humanities. Motivated by ethical as well as scholarly concerns, eco-criticism not only enacts a fundamental examination of nature as an ideological construct, but also seeks to investigate the complex interrelationship between humanity and the environment. Concurrently, there has been a marked interest in studying the role of “green issues” in contemporary art, particularly in tracing the development of earth art or eco-art from the early 1970s to the present. The goal of this seminar is to forge a link between these two emergent strands by tracing the complex relationship between art and the environment from the nineteenth-century to the present, seeking to thereby assess the capaciousness of eco-criticism as a methodological approach to art history. Offered as ARTH 382, ARTH 482 and ESTD 382. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 383. Gender Issues in Feminist Art: The 20th/21st Century. 3 Units.  
This course aims at understanding the myriad ways issues of gender have been encoded and/or played out in 20th and early 21st century art. A variety of paintings, sculpture, photographs and performances by women, gays and other marginalized groups, especially those that engage in “the discourse of the body,” will be examined through a gender-oriented focus. Analysis of a variety of provocative readings will provide methodologies useful for assessing aesthetic and political meanings in modern and contemporary art across national boundaries. Special emphasis will be placed on women artists who have recently begun to integrate gender and ethnicity. Offered as ARTH 383, WGST 383 and ARTH 483. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 384. American Art and Architecture in the Age of Washington and Jefferson. 3 Units.  
In the 18th century, Americans created not only a political revolution but an artistic and creative one as well. In the 17th century, most Americans were subsistence farmers and most of their products, manufactures, and buildings were relatively crude. In the 18th century, Americans not only established a new and lasting form of government, but for the first time produced paintings, buildings, furniture and silver that rivaled the finest productions of Europe. Notably, many of the leaders of the American Revolution, such as Paul Revere, George Washington, and Thomas Jefferson, also made significant contributions to the arts. Offered as ARTH 384 and ARTH 484.

ARTH 385. American Avant-Garde: 1900 - 1925. 3 Units.  
An examination of the development of avant-garde styles in New York during the early twentieth century. In-depth discussion of the Photo-scession, Stieglitz’s “291” gallery, the Armory Show, Marcel Duchamp’s move to America, and the formation and demise of the New York Dada movement. Offered as ARTH 385 and ARTH 485.

ARTH 386. Issues in American Art. 3 Units.  
Various topics in American art. Each offering will focus on a specific topic within American art. Lectures, discussions, and report. The course will entail regular oral classroom reports and short writing assignments as well as a final paper. Producing an intellectually significant final paper is the major goal of the class. Graduate students are expected to produce a final paper of greater length than Undergraduates and that shows evidence of original scholarship. Offered as ARTH 386 and ARTH 486.

ARTH 389. Honors Thesis. 3 Units.  
Intensive study of a topic or problem leading to the preparation of an honors thesis.
ARTH 401. Museums and Globalization. 3 Units.
Museums are everywhere contested spaces today. Historically designed as symbols of power, centers for research, agents of public education and community formation in Western industrial societies, they have become sites of development and cultural controversy on a global scale. From Cleveland and Paris to Nairobi and Dubai museums figure in urban redevelopment, national identity formation, conflicts between religion and science, and global tourism. Questions we will consider in this course: what are the fundamental features of museums as institutions? what ties have linked them to wider national and international communities of academics, NGO’s and business? to political, economic and social concerns? how do museums in Asia, Africa, the Middle East, and Latin America figure in the current international contention over heritage rights? This is an innovative course allowing students to collaborate on projects, engage with guest lecturers and access museums across the globe. The course is organized in three parts: Part I: National Identity Building and Museums; Part II: Museums and Identity Politics; Part III: Museums and Global Development. Offered as HSTY 329, ARTH 301, HSTY 429, and ARTH 401. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 402. Buddhist Art in Asia. 3 Units.
This course explores the visual and material culture of Buddhism in Asia from its origins in India to its transmission and transformation in China, Korea, Japan, Tibet, Thailand, Cambodia and Indonesia. Our historically and culturally structured examination traces major developments in Buddhist art and their relationships with belief, practice, and ritual. We consider the ways that artistic traditions have adapted and evolved both within individual cultures and cross-culturally. We primarily focus on studying the historical contexts for sculpture, architecture, and painting, but we also consider the movement of Buddhist works from temples to sites of secular display in museums around the world, and the religious, cultural, and ethical issues that arise from these moves. Topics include: representations of the life of the historical Buddha; visual programs of temples; artistic representations of paradies and hells; sacred sites and architecture; imperial patronage of Buddhist art; the role of art in pilgrimage and ritual; and visual imagery associated with Pure Land, Chan, Zen and esoteric traditions. Visits to and engagement with objects in the new Asian galleries at the Cleveland Museum of Art provide a rich environment for our class sessions and student projects. Offered as ARTH 302 and ARTH 402. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 407. Arts of China. 3 Units.
This course explores a selection of major developments in Chinese visual and material culture from ancient times to the present day. We consider works in multiple media including bronzes, pottery, sculpture, calligraphy, paintings, ceramics and installations. We look into the roles of art in society, the relationship of art to political authority, the place of art in religious practice and experience, connections between art and literature, and how art relates to the expression of personal, social, political, and cultural identity. We pay particular attention to landscape painting; pictorial and sculptural programs of Buddhist grottoes; art commissioned and collected by the imperial court; objects associated with Daoist, Buddhist, and Confucian religious practices and sacred sites; art produced during periods of non-Chinese rule under the Mongols and Manchus; the affects of foreign styles and ideas on artists; and the role of Chinese artists in the contemporary global art world and market. We also examine the role of museums in selecting, preserving, and presenting Chinese art in the 20th and 21st century. Visits to the Cleveland Museum of Art form an integral part of the course. Offered as ARTH 307 and ARTH 407. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 408. Daoism: Visual Culture, History and Practice. 3 Units.
This course explores developments in the visual culture, history and practices of Daoist religious traditions in China from the third to twentieth centuries. Our historically and conceptually structured examination draws upon a balance of visual, textual, and material sources, while considering the various approaches scholars have employed to understand the history and development of Daoist traditions. Topics include: sacred scriptures and liturgies, biographies and visual narratives, iconography and functions of the pantheon of gods and immortals, views of the self and the body, practices of inner alchemy and self-cultivation, thunder deities and exorcism, dietetics and medicine and modes of meditation and ritual. Offered as ARTH 308, ARTH 408, and RLGN 308. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 411. Rome: City and Image. 3 Units.
This course studies the architectural and urban history of Rome from the republican era of the ancient city up to the eighteenth century using the city itself as the major “text.” The emphasis will be placed on the extraordinary transformations wrought in the city, or at least in key districts, by powerful rulers and/or elites, especially in the ancient empire and in the Renaissance and baroque eras. In a larger perspective, the great construction projects exerted a far-reaching effect within and beyond Europe, but we will study them in relation to their topographical situation, their functions, and their place in a long history of variations on prestigious themes since many of the artworks and the urban settings featured in the course carry the mark of the Long history of the city itself. Recommended preparation: At least one 200-level course in ANTH, ARTH, CLSC, ENGL, HSTY, or RLGN. Offered as ARTH 311, ARTH 411, and CLSC 311. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 425. Art at the Crossroads of Religion: Polytheistic, Christian, and Islamic Art in Antiquity. 3 Units.
People often single out the reign of Constantine (A.D. 306-337) as the point in history when Rome transformed from a polytheistic empire to a Christian empire. This course questions the strict divide between the categories of “pagan” and “Christian” in Rome in the imperial period and beyond. Through a close examination of the artistic and architectural record, students will come to understand that this dichotomy is a modern invention; for people living in the Roman Empire, religious identities were extraordinarily fluid. Indeed, traditional polytheistic religion and Christianity remained closely intertwined for centuries after Constantine “Christianized” the Empire. Moreover, religious pluralism had been a fundamental part of Roman culture since the founding of ancient Rome. We will survey a range of material culture, including public statuary, sarcophagi, silver hordes, and temples and churches. We will also examine sites such as the border city of Dura-Europos in Syria to explore how religious identities in the Roman Empire (including Judaism, early Christianity, and so-called mystery cults) intertwined even when Rome was still supposedly a “pagan” Empire. The course pays particular attention to the art and architecture produced under Constantine, whom people today often remember as Rome’s first Christian emperor but who represents, in fact, a complex amalgam of polytheistic and monotheistic practices and identities. We will also explore how Christian art slowly but ultimately became the predominant visual culture in the Roman Empire. Finally, we will examine how Early Islamic art and architecture exploited the Greco-Roman visual tradition to the ends of this new religion. Offered as ARTH 325, ARTH 425 and CLSC 325. Counts for CAS Global & Cultural Diversity Requirement.
ARTH 427. The Parthenon Then and Now: New Discoveries, Old Problems and Reception. 3 Units.
The Parthenon is an icon of western art and culture. Over 250 year of scholarship on this world-renowned building have revealed many of its secrets, but numerous questions still remain. New finds on the Acropolis itself and elsewhere in Greece have shed light on some of these issues, and as a result new theories abound. This seminar offers an overview of the temple, its architecture and sculpture, and will investigate its place in the civic and religious ideology of classical Athens. The course will also trace the Parthenon’s many post-classical permutations, into a Christian Church and an Islamic mosque, and its impact on later western art and architecture. Finally the class will debate the moral and ethical issue of the Elgin Marbles - to repatriate them to Greece or to retain them in the British Museum in perpetuity. Offered as ARTH 327, ARTH 427, CLSC 327, and CLSC 427. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 429. Marvels of Rome: Monuments and Their Decoration in the Roman Empire. 3 Units.
This course examines some of the most famous monuments of the Roman Empire, including Nero’s Golden House, the Colosseum, the Pantheon, Hadrian’s Villa at Tivoli, and the lavish villa of Piazza Armerina in Sicily. We will study each monument in depth, delving into the architecture, paintings, sculptures, mosaics, and social functions of each monument. Students will learn how to analyze artistic and archaeological evidence, ancient textual evidence (poems, prose, and inscriptions), and secondary scholarship to reconstruct the visual appearances and historical and cultural contexts of the monuments in questions. Throughout the course, students will gain a new appreciation and deeper understanding of some of the most iconic buildings of the classical tradition. Offered as ARTH 329, ARTH 429, and CLSC 329. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 432. Art and Archaeology of Ancient Italy. 3 Units.
The arts of the Italian peninsula from the 8th century B.C. to the 4th century A.D., with emphasis on recent archaeological discoveries. Lectures deal with architecture, sculpture, painting, and the decorative arts, supplemented by gallery tours at the Cleveland Museum of Art. Offered as ARTH 332, CLSC 332, and ARTH 432.

ARTH 433. Greek and Roman Painting. 3 Units.
Greek vase painting, Etruscan tomb painting and Roman wall painting. The development of monumental painting in antiquity. Offered as ARTH 333, CLSC 333, and ARTH 433.

ARTH 434. Art and Archaeology of Greece. 3 Units.
A survey of the art and architecture of Greece from the beginning of the Bronze Age (3000 B.C.) to the Roman conquest (100 B.C.) with emphasis on recent archaeological discoveries. Lectures deal with architecture, sculpture, painting, and the decorative arts, supplemented by gallery tours at the Cleveland Museum of Art. Offered as ARTH 334, CLSC 334, and ARTH 434.

ARTH 435. Issues in Ancient Art. 3 Units.
Various topics in Ancient art. Lectures, discussions and reports. Offered as ARTH 335 and ARTH 435.

ARTH 436. Representations of War in Ancient Rome. 3 Units.
Few societies in history have been as militaristic as ancient Rome-- or as proud of their warrior culture. This course examines the many ways that Romans constructed and contested their conceptions of war from the founding of the Roman Republic in 509 B.C.E. to the reign of Constantine (306-337 C.E.). Why did Romans choose to represent war in certain ways, and how did these artistic representations shape Romans’ military values? What can the visual record tell us about how different groups (soldiers, women, slaves) experienced war in the Roman world? We will explore major public monuments in the city of Rome (including triumphal arches and the Colosseum) and private objects (such as silver drinking vessels) to observe how Roman militarism pervaded different walks of life. We will also examine monuments on the edges of Rome’s empire, such as the towering trophies in modern France and Romania, to explore how works of art and architecture mediated the relationship between Romans and the peoples they conquered. Students will be encouraged to think about how art and architecture contributed to the construction of militarism as a chief Roman value, but also about how visual representations provided an important means to debate the value of Rome’s military efforts, to subvert Rome’s rigidly hierarchical social order, and to grapple with what it meant to “be Roman” as wars transformed Rome from a small city in Italy to a massive, pan-Mediterranean empire. After exploring Romans’ conceptions of war and victory, students also may ask whether the common comparison between the Roman Empire and modern America is appropriate. Offered as ARTH 336, ARTH 436 and CLSC 336. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 440. Issues in the Art of China. 3 Units.
This is a topics course. Each offering will focus on a specific topic within the area of Chinese art. Sample topics may include: Women painters in Beijing, Modern Artists in China-1980-Present, Shang Dynasty Tombs, Yuan Dynasty Buddhist Art. Lectures, discussions, and reports. Offered as ARTH 340 and ARTH 440.

ARTH 441. Issues in the Art of Japan. 3 Units.
This is a topics course. Each offering will focus on a specific topic within the area of Japanese art. Sample topics may include: Muromachi Hanging Scrolls, Ryoan-ji Temple Garden Architecture, Rimpa School Panel Screens, Buddhist Painting in the Edo Period. Lectures, discussions, and reports. Offered as ARTH 341 and ARTH 441.

ARTH 442. Issues in Indian and Southeast Asian Art. 3 Units.
This course covers topics in the history of India and neighboring regions with emphasis on connections with works in the Cleveland Museum of Art. Offerings include The Buddha Image, Murals and Manuscripts, The Hindu Temple, Krishna in Art and Literature, and the History of Mughal Painting. Lectures, discussions, and reports. Offered as ARTH 342, ARTH 442, and HSTY 324. Counts for CAS Global & Cultural Diversity Requirement.
ARTH 449. Gothic Art: Vision and Matter. 3 Units.
This course will examine the development and dissemination of Gothic art in Western Europe in the High and Late Middle Ages. We will consider a variety of media, including architecture, metalwork, sculpture, manuscript illumination, panel paintings, fresco cycles, and small devotional objects. As we study medieval art in its socio-historical contexts—private and public, monastic and political, liturgical and lay—we will pay special attention to issues of patronage, relationships between texts and images, the introduction of visionary and mystical devotion, attitudes towards education and authority, differences between male and female piety, modes of medieval viewing, and reception and manipulation of art by medieval audiences. Visits to the CMA will form an integral part of the course. Offered as ARTH 349 and ARTH 449. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 450. Issues in Medieval Art. 3 Units.
Various topics in Medieval Art. Lectures, discussions, and reports. Offered as ARTH 350 and ARTH 450.

ARTH 452. Italian Art of the 15th Century. 3 Units.
The early 15th century in Florence, civic humanism, the sculpture of Ghiberti and Donatello, the painting of Masaccio, the International Style in painting, the art of Uccello, Piero della Francesca, Mantegna, and Botticelli; Carpaccio and the Bellini in Venice. Offered as ARTH 352 and ARTH 452.

ARTH 453. Sixteenth Century Italian Art. 3 Units.
The development of the High Renaissance and Mannerist styles in Italy and late 16th century trends: painting and sculpture. Offered as ARTH 353 and ARTH 453.

ARTH 455. The Book in the Middle Ages: The Christian, Jewish, and Islamic Tradition. 3 Units.
This course will examine later medieval manuscript production, paying particular attention to the issues of patronage, gender, literacy, reception, and cultural biases. We will explore the imagery and texts of monastic and courtly manuscripts, travel books and devotional manuals, all within the framework of the tightly interwoven theological and social discourses of the institutions that commissioned them. As the title of the course indicates, we will study Christian, Jewish, and Islamic books and their interrelations; for example, we will compare Islamic encyclopedias of the natural world, such as Zakariya ibn Muhammad al-Qazwini’s illustrated Wonders of Creation, with medieval bestiaries, herbs, and encyclopedias such as Hartman Schedel’s Liber Chronicarum and Les Merveilles du Monde. Each religious culture will receive a special close-study spotlight: Jewish Haggadot (books for the Passover Seder), Christian courtly romances, and Islamic manuscripts of the Shahnama epic. Offered as ARTH 355 and ARTH 455. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 457. Medieval Wonders: Monuments from Across the Globe. 3 Units.
This course will introduce art of the medieval world, considered globally, with a special focus on monuments surviving from the seventh to fifteenth centuries. Emphasis will be on sculpture and architecture; other media—manuscript illumination, wall paintings, ceramics, and metalwork—will be discussed in conjunction with the related sites. We will travel, virtually, to Pre-Columbian Yucatan, Judeo-Christian Europe, Islamic Spain and Central Asia, Hindu and Buddhist India, Tibet, and Southeast Asia. Each week one or two monuments will be discussed in depth, and other sites will be introduced to place it into historical and art historical contexts. Among the themes we will explore are the power relationships between sovereignty and religion; visual expressions of politics and propaganda; the ways literature, performance, and devotion informed medieval material culture; the importance of pilgrimage; and influences of international trade. Ethical and nationalist issues surrounding looting and cultural patrimony will also be discussed. Objects from CMA’s permanent collections will form an integral part of the course. Each unit will end with the consideration of collecting practices. Offered as ARTH 357 and ARTH 457.

ARTH 458. Medieval Body. 3 Units.
This course will explore the meanings and representations of the body in western medieval culture. Topics will include bleeding bodies, fragmented bodies, lactating bodies, labile bodies, cosmic bodies, physiological bodies, mystical bodies, suffering bodies, edible bodies, enclosed bodies, gendered bodies, Christ’s bodies, Mary’s bodies, decomposing bodies, macabre bodies, resurrected bodies, dead bodies, intercessory bodies, unhinging bodies, translucent bodies, martyred bodies, desirable bodies, desirous bodies, abhorrent bodies, mimetic bodies, nude bodies, marginalized bodies, defleshed bodies, social bodies, political bodies, monstrous bodies, mnemonic bodies, and deformed bodies. We will explore the complex rhetoric of embodiment as it manifests itself in the ambiguous discourse—both medieval and contemporary—on the relationships between the material and intangible, spiritual and physical, somatic and mental, corporeal and ethereal. Offered as ARTH 358 and ARTH 458. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 459. Visual Culture of Medieval Women. 3 Units.
This course will consider the roles of women as patrons, subjects, producers and consumers of visual culture, focusing particularly on the twelfth through fifteenth centuries. Throughout the course, we will study the different ways medieval men and women perceived, read, figured, and interacted with the female body, which was frequently seen as a fraught site of desire and repulsion, fear and fascination. Students will be asked to read primary sources as well as critical materials that address contradictory constructions of gender and sex in medieval images and texts. The course, therefore, will not simply focus on artistic production, but will include readings and discussions of social and political history, theology, and literature of the Middle Ages. Offered as ARTH 359 and ARTH 459; cross-listed as WGST 359 since it focuses on the role of women in visual culture and so can satisfy a requirement in the program for the course on women in the arts. Offered as ARTH 359, ARTH 459 and WGST 359. Counts for CAS Global & Cultural Diversity Requirement.
ARTH 460. Renaissance Art in Northern Europe. 3 Units.
Painting, sculpture, and the graphic arts in Belgium, France, Germany, and The Netherlands, 1400-1580, highlighting the careers and contributions of specific artists such as Jan van Eyck, Albrecht Durer, and Pieter Bruegel. We will also analyze the changing social, cultural, religious, and political circumstances of the art made during this period, which saw the invention of printmaking, the Protestant Revolution, and increased strife between rulers and their subjects. The rise of new subjects such as landscape and scene of everyday life will be explored, and changes in patronage will be discussed, concentrating on the shift from church and noble patronage to increasingly middle-class patronage related to the beginnings of the open art market. Offered as ARTH 360 and ARTH 460. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 461. 17th-Century Art in Belgium and The Netherlands. 3 Units.
The arts of painting, drawing, and printmaking in Belgium and The Netherlands are discussed in relationship to political, social, cultural, and religious contexts. We will explore the careers and production of individual artists such as Rubens, Van Dyck, Hals, Rembrandt, and Vermeer. Developments in new subjects, artistic specialization, and the expansion of the open market are seen as important factors in shaping Belgian and Dutch art. Offered as ARTH 361 and ARTH 461. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 462. Issues in Early Modern Southern European Art. 3 Units.
Various topics in the art of southern Europe, 1400-1800. Lectures, discussions, reports, and gallery visits in the CMA. Offered as ARTH 362 and ARTH 462. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 465. Issues in Early Modern Northern European Art. 3 Units.
Various topics in the art of northern Europe, 1400-1800. Lectures, discussions, reports, and gallery visits in the CMA. Offered as ARTH 365 and ARTH 465. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 474. Impressionism to Symbolism. 3 Units.
Major developments in European painting and sculpture during the latter half of the nineteenth century. Post-impressionism synthetism, symbolism, and the arts and crafts movement considered in their socio-cultural contexts. Works of Degas, Manet, Monet, Klimt, Bocklin, Gauguin, etc. Offered as ARTH 374 and ARTH 474.

ARTH 479. Issues in 19th Century Art. 3 Units.
Various topics in 19th century art, with class lectures, discussions and reports. Consult department for current topic. Offered as ARTH 379 and ARTH 479.

ARTH 480. Abstract Expressionism and Its Aftermath. 3 Units.
An examination of the development and influences of Abstract Expressionism, including the impact on the Beat Generation and Pop Art. Offered as ARTH 380 and ARTH 480.

ARTH 482. Art, Eco-criticism, and the Environment. 3 Units.
As issues of sustainability and environmental impact have become increasingly dominant concerns in contemporary society, eco-criticism has emerged as a vital methodological thread across the humanities. Motivated by ethical as well as scholarly concerns, eco-criticism not only enacts a fundamental examination of nature as an ideological construct, but also seeks to investigate the complex interrelationship between humanity and the environment. Concurrently, there has been a marked interest in studying the role of “green issues” in contemporary art, particularly in tracing the development of earth art or eco-art from the early 1970s to the present. The goal of this seminar is to forge a link between these two emergent strands by tracing the complex relationship between art and the environment from the nineteenth-century to the present, seeking to thereby assess the capaciousness of eco-criticism as a methodological approach to art history. Offered as ARTH 382, ARTH 482 and ESTD 382. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 483. Gender Issues in Feminist Art: The 20th/21st Century. 3 Units.
This course aims at understanding the myriad ways issues of gender have been encoded and/or played out in 20th and early 21st century art. A variety of paintings, sculpture, photographs and performances by women, gays and other marginalized groups, especially those that engage in “the discourse of the body” will be examined through a gender-oriented focus. Analysis of a variety of provocative readings will provide methodologies useful for assessing aesthetic and political meanings in modern and contemporary art across national boundaries. Special emphasis will be placed on women artists who have recently begun to integrate gender and ethnicity. Offered as ARTH 383, WGST 383 and ARTH 483. Counts for CAS Global & Cultural Diversity Requirement.

ARTH 484. American Art and Architecture in the Age of Washington and Jefferson. 3 Units.
In the 18th century, Americans created not only a political revolution but an artistic and creative one as well. In the 17th century, most Americans were subsistence farmers and most of their products, manufactures, and buildings were relatively crude. In the 18th century, Americans not only established a new and lasting form of government, but for the first time produced paintings, buildings, furniture and silver that rivaled the finest productions of Europe. Notably, many of the leaders of the American Revolution, such as Paul Revere, George Washington, and Thomas Jefferson, also made significant contributions to the arts. Offered as ARTH 384 and ARTH 484.

ARTH 485. American Avant-Garde: 1900 - 1925. 3 Units.
An examination of the development of avant-garde styles in New York during the early twentieth century. In-depth discussion of the Photo-secession, Stieglitz’s “291” gallery, the Armory Show, Marcel Duchamp’s move to America, and the formation and demise of the New York Dada movement. Offered as ARTH 385 and ARTH 485.

ARTH 486. Issues in American Art. 3 Units.
Various topics in American art. Each offering will focus on a specific topic within American art. Lectures, discussions, and report. The course will entail regular oral classroom reports and short writing assignments as well as a final paper. Producing an intellectually significant final paper is the major goal of the class. Graduate students are expected to produce a final paper of greater length than Undergraduates and that shows evidence of original scholarship. Offered as ARTH 386 and ARTH 486.

ARTH 489. M.A. Qualifying Paper. 3 Units.
Individual research and intensive study of a specific topic in art history that culminates in a written M.A. Qualifying Paper. Prereq: To be taken only after completion of 18 credit hours of graduate Art History coursework.
ARTH 490A. Visual Arts and Museums I. 3 Units.
This course examines the idea of the art museum in both its historical and contemporary manifestations, focusing on the context of Western Europe and the United States. As a result of this course, students should be familiar with the following topics: the historical development of the museum, from its origins in collecting practices to its modern incarnation as an institution; the development and care of a collection, including acquisition, cataloguing, and conservation; the display and housing of a collection, including internal and external museum architecture; the study and interpretation of the collection/exhibition, considering diverse publics; the governance of the institution, including project management, finance, and administration. Through the study of these topics, the student should be familiar with the following concepts: the museum as a place for learning, research and scholarship and the museum as steward of cultural property and the attendant issues of ethics and the law. ARTH 490A concentrates on museum collections and related aspects of care, research, interpretation and scholarship. Students who successfully complete ARTH 490A and ARTH 490B may be considered for admission into ARTH 491A, a supervised internship in an art museum or gallery situation.

ARTH 490B. Visual Arts and Museums II. 3 Units.
This course examines the idea of the art museum in both its historical and contemporary manifestations, focusing on the context of Western Europe and the United States. As a result of this course, students should be familiar with the following topics: the historical development of the museum, from its origins in collecting practices to its modern incarnation as an institution; the development and care of a collection, including acquisition, cataloguing, and conservation; the display and housing of a collection, including internal and external museum architecture; the study and interpretation of the collection/exhibition, considering diverse publics; the governance of the institution, including project management, finance, and administration. Through the study of these topics, the student should be familiar with the following concepts: the museum as a place for learning, research and scholarship and the museum as steward of cultural property and the attendant issues of ethics and the law. ARTH 490B concentrates on museum collections and related aspects of care, research, interpretation and scholarship. Students who successfully complete ARTH 490A and ARTH 490B may be considered for admission into ARTH 491A, a supervised internship in an art museum or gallery situation.

ARTH 491A. Visual Arts and Museums: Internship. 1 Unit.
Recommended preparation: ARTH 490.

ARTH 491B. Visual Arts and Museums: Internship. 3 Units.
Second semester of Internship sequence. This internship focuses on the implementation of a comprehensive project that would serve a function similar to the requirement of a qualifying paper for the completion of a master's degree in art history. It is recommended that students undertake this internship in the same division in which their first internship was situated although students may find opportunities to parlay the skills acquired in the first internship to successful advanced work in another division. The key distinction here is that the work in ARTH 491B should build upon the expertise developed in ARTH 491 and represent a significant advance in responsibilities and skills. By week 10 of ARTH 491, students should begin to identify a potential project for ARTH 491B. By the first week of the semester in which ARTH 491B is to be completed, the student must file an internship agreement form with the department that includes a brief description of the project to be completed, including a summary of the project and major milestones/time line. In addition to working under the direct supervision of a museum mentor, the student must obtain a faculty mentor for the project and this information should be included in the internship agreement form.

Students must file a midterm and final report describing their duties and responsibilities and a self-assessment of their performance and a final portfolio with a final version of their project as well as examples of drafts and feedback received in the course of completing the project. Students must also keep a journal that tracks their milestones in completing their projects. The faculty supervisor will solicit a letter of assessment from the internship supervisor immediately upon the close of the internship and in sufficient time for final grades. Recommended preparation: ARTH 490, ARTH 491A.

ARTH 492. Issues in 20th/21st Century Art. 3 Units.
Various topics in 20th/21st century art, with class lectures, discussions, and reports. Offered as ARTH 392 and ARTH 492.

ARTH 493. Contemporary Art: Critical Directions. 3 Units.
An examination of the directions taken by avant-garde American art and criticism in the aftermath of Abstract Expressionism. Includes the rise and fall of modernism in the 1960s and '70s, as well as an investigation of Post-modern trends and theories. Offered as ARTH 393 and ARTH 493.

ARTH 494A. Directed Readings in Asian Art. 1 - 3 Units.
Directed reading.

ARTH 494B. Ancient Art. 1 - 3 Units.

ARTH 494C. Medieval Art. 1 - 3 Units.

ARTH 494D. Renaissance and Baroque Art. 1 - 3 Units.

ARTH 494E. American Art. 1 - 3 Units.

ARTH 494F. Modern Art. 1 - 3 Units.

ARTH 495. Methodologies of Art History. 3 Units.
The study of art history as a discipline in its practical and theoretical aspects. Consideration given to research methods, style and historical context, and a critical examination of selected major art historical texts with a view to understanding traditional as well as recent approaches. Special attention is given to art historical writing, employing selected original works in the Cleveland Museum of Art. Required of first-year graduate students in the Ph.D. and Master's programs.
ARTh 496. Materials, Methods, and Physical Examination of Works of Art. 3 Units.
This foundational course will introduce students to the examination methods, terminology and goals of art conservation as it supports art historical research and practice. Students will learn about the various materials that make up different kinds of works of art, how these materials have been used, and what can be learned by the physical examination of works of art. Emphasis will be placed on understanding the uses of and results obtained with imaging techniques (such as X-radiography, infrared reflectography) and on what can be learned through the trained use of the human eye alone. While art from the western tradition, particularly from the 14th through the 21st centuries will be emphasized in class examples, comparisons will be made to objects from other global cultures. The growing field of technical art history, where the results of physical examination are used to illuminate art historical issues such as how workshops functioned, will be considered as well. Each student will research one work of art in the Cleveland Museum of Art or other local collections to understand the physical history and current condition of that object. The goal will be for students to gain an informed understanding of how to evaluate the condition of a work of art, of what options are available for conservation treatment, and of what art-historical information can be obtained through physical examination.

ARTh 498. History and Practice of Connoisseurship. 3 Units.
In this seminar we will consider the history, historiography, and practice of connoisseurship. In western cultures connoisseurship, the practice of attributing works of art to specific artists, regions, and time periods and assessing their quality, can be traced back to classical antiquity. It was practiced with renewed vigor in Europe from the sixteenth century onward and in the nineteenth century was a foundational methodology for the academic discipline of art history. While it came under criticism in the twentieth century as a method too closely aligned with the art market, connoisseurship continues to be practiced today, especially in museums and auction houses, as a vital and necessary methodological approach. In recent decades art historians have also begun to reevaluate the history, practices and historiographic importance of this methodology. Class discussions of the scholarly literature of connoisseurship and case studies of its practice will alternate with sessions held in the Cleveland Museum of Art to examine objects from the permanent collections. The museum sessions, led by curators and conservators, will also emphasize the role that physical condition plays in making connoisseurship assessments. Specific topics will be designated each time the course is offered. Prereq: ARTH 495.

ARTh 512. Seminar in Ancient Art. 3 Units.

ARTh 517. The History of Collecting and Exhibiting Asian Art. 3 Units.
This graduate seminar explores major themes, individuals, institutions, types of objects, and eras in the history of collecting and exhibiting Asian art. Adopting a cross-cultural and comparative approach, we investigate practices of collecting and display within Asia, and in Britain, Europe, and the United States. We examine personal, institutional, cultural, and national aims for collecting as well as processes involved in collection formation. We also consider how exhibitions have served as social agents of discourse, acts of cultural diplomacy, and their impact on the evolution of artistic canons. Topics include cross-cultural transfer and re-framing of objects; divergent connoisseurship practices and aesthetic tastes; overlapping roles of private collectors, dealers, curators, and scholars; political, economic, and social factors that affected collecting and display; exhibitions and collections as expressions of cultural and national identity; the roles of imperialism and colonialism; and the circulation of objects in global art markets. Areas and topics rotate.

ARTh 518. Seminar in Asian Art. 3 Units.

ARTh 545. Seminar in Medieval Art. 3 Units.

ARTh 551. Seminar in Early Modern Southern European Art. 3 Units.

ARTh 552. Seminar in Early Modern Northern European Art. 3 Units.

ARTh 565. Seminar in American Art. 3 Units.

ARTh 570. Seminar: 19th Century Art. 3 Units.

ARTh 576. Seminar in Modern Art. 3 Units.

ARTh 601. Research in Art History. 1 - 18 Units.

(ARTh 610A. Advanced Visual Arts and Museums: Internship I. 3 Units.
First semester of the internship sequence. The intern will work under the supervision of a museum professional to plan and execute a specific project. The student must also obtain a faculty mentor for the project. An internship agreement form must be filed with the department by the end of the first week of classes that includes a brief description of the project. If it is a project to be completed in one semester, a time line should be included as well. The intern must file a mid-term and final report describing their duties and responsibilities and a self-assessment of their performance. A portfolio kept in the department will include the final version of their project as it stands at the end of the semester, as well as examples of drafts and any evaluation received in the course of completing the project. The intern must also keep a journal that tracks their milestones in the execution of their project. The faculty supervisor will solicit a letter of assessment from the museum supervisor immediately upon the close of the internship and in sufficient time to assign a final grade.

ARTh 610B. Advanced Visual Arts and Museums Internship II. 3 Units.
Second semester of the internship sequence. The intern will either continue with the execution of the project begun in the first semester (ARTh 610A) or, when appropriate, undertake a new project. The intern will work under the supervision of a museum professional, and must obtain a faculty mentor for the project. An internship agreement form must be filed with the department by the end of the first week of classes that includes a brief description of the project. A time line should be included as well. The intern must file a mid-term and final report describing their duties and responsibilities and a self-assessment of their performance. A portfolio kept in the department will include the final version of their project as it stands at the end of the semester, as well as examples of drafts and any evaluation received in the course of completing the project. The intern must also keep a journal that tracks their milestones in the execution of their project. The faculty supervisor will solicit a letter of assessment from the museum supervisor immediately upon the close of the internship and in sufficient time to assign a final grade. Prereq: ARTH 610A.

ARTh 701. Dissertation Ph.D.. 1 - 9 Units.

(ARTh as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

ARThs Courses

ARTh 101. Design and Color I. 3 Units.
Organizational and structural projects as a basis for the development of style. Studies in line, texture, shape, space, value, color, and two dimensional composition through studio problems, art studio media and techniques.
ARTS 106. Creative Drawing I. 3 Units.
Development of graphic fluency in black and white through direct observation of nature and the model. Drawing as a means of enlarging visual sensitivity using a wide range of media and subject matter. Work from nude model.

ARTS 201. Design and Color II. 3 Units.

ARTS 206. Creative Drawing II. 3 Units.
Continuation of ARTS 106. Advanced work in graphic representation. Development of visual acuity and a personal drawing style while working in color. Work from nude model. Prereq: ARTS 106.

ARTS 210. Enameling and Jewelry I. 3 Units.
Techniques in the application of vitreous enamel on copper and of constructed metal jewelry. Technical skill and suitability of design as applied to the medium.

ARTS 212. Weaving, Fibers, and Textiles I. 3 Units.

ARTS 214. Ceramics I. 3 Units.
The techniques of hand building in pinch, coil and slab methods. Development of sensitivity to design and form. Basic work in stoneware, earthenware, and glazing.

ARTS 216. Painting I. 3 Units.
The creative, conceptual, visual, and technical aspects of painting. Style ranging from naturalism to abstraction. Work in acrylic and mixed media.

ARTS 220. Photography Studio I. 3 Units.
Camera, film, and darkroom techniques. Development of basic black and white perceptual and photographic skills. Darkroom and photographic field and lab work. 35mm camera required.

ARTS 295. Introduction to Art Education. 3 Units.
General history and theories of art education. Development of personal philosophy as basis for teaching art. Topics in professional standards, creativity, aesthetic theory, and art criticism. (Clinical/field experience required.)

ARTS 300. Current Issues in Art Education. 3 Units.
Contemporary issues in Art Education; understanding art goals and standards of National Art Education Association and the Ohio State Department of Education for teachers, students and administrators. Special topics: art and technology, multiculturalism, special populations and classroom management. Offered as ARTS 300 and ARTS 400. Prereq: ARTS 295.

ARTS 302. Architecture and City Design I. 3 Units.
The social spatial, and aesthetic elements in architecture; the components of the building: the window, door, roof, enclosing walls, and character of interior and exterior space. Projects related to small, intimate scale and residential structures. Lectures, field trips, studio experiences. Recommended ARTS 101 or ARTS 106 courses prior to enrollment. Offered as ARTS 302 and ARTS 402.

ARTS 303. Architecture and City Design II. 3 Units.
The social, spatial, and aesthetic elements of the urban setting of architecture, the organizational components of the city, the path, the node, the edge, and the grid. Projects related to large-scale and public buildings and their relationship to the encompassing visual world. Lectures, field trips, studio experiences. Recommended ARTS 101 or ARTS 106 courses prior to enrollment. Offered as ARTS 303 and ARTS 403.

ARTS 304. Architecture and City Design III. 3 Units.
A study of historic precedents and the social implications of modern and contemporary architecture including analysis and form interpretation as it relates to building and materials technologies. Practical application and synthesis of architectural knowledge through site visits and research of local and regional architecture. Discussions of historic and contemporary architects, engineers and significant architecture and engineering firms. Prereq: ARTS 302 and ARTS 303.

ARTS 305. Study Abroad: Architecture, Design & Culture. 3 Units.
Problem Solving is at the very core of Design, and every city is inventive in its own unique way when it comes to Problem Solving, based on its history, culture, geography and native materials. This intensive international summer course immerses students into a culture that solves architectural problems through a sophisticated appreciation for design, aesthetics and conceptualization. The program introduces students to critical inquiry through the shared principles and theories of Art, Architecture, and Design, as experienced in an international cultural center. Using the city as our classroom, students will visit well-known sites, museums and monuments as well as hidden gems that reinforce the concepts presented in readings and reviewed in class discussions. While no art or drawing skills are required, participants at every level will learn how to improve their visual skills through sketching, observation studies, and analyses. Each week students will complete a design project, each exploring a different aspect of the culture. The course offers Global and Cultural Diversity credit and is open to undergraduate students and graduate students. There is no language requirement for this course. Offered as ARTS 305 and ARTS 405. Counts for CAS Global & Cultural Diversity Requirement.

ARTS 310. Enameling and Jewelry II. 3 Units.

ARTS 312. Weaving, Fibers, and Textiles II. 3 Units.
Continuation of ARTS 212. Exploration of a selected area of textiles in surface design or constructed textiles. Development of a personal aesthetic through design and execution of a series of projects. Prereq: ARTS 212.

ARTS 314. Ceramics II. 3 Units.

ARTS 316. Painting II. 3 Units.
The creative, conceptual, visual and technical aspects of painting. Styles ranging from expressionism, cubism, surrealism and abstraction. Work in acrylic and mixed media leading to the development of personal painting style. Prereq: ARTS 216.
ARTS 320. Photography Studio II. 3 Units.
Continuation of ARTS 220. Advanced theory and black and white techniques. Development of personal aesthetic encouraged. Field work. 35mm camera required. Prereq: ARTS 220.

ARTS 322. Digital Photography I. 3 Units.

ARTS 323. Creative Digital Photography II. 3 Units.
Creative Digital Photography II: Advanced theory and techniques of the digital photography workflow and its application to creative photography. Field and computer lab work. Advanced amateur digital camera and access to Photoshop CS6 required. Prereq: ARTS 322.

ARTS 325. Creative Photography. 3 Units.
Creative photography through photographing and responding to photographs. The question of self-expression and photographic medium explored in the pursuit of understanding images. Prereq: ARTS 220 and ARTS 320 or ARTS 322.

ARTS 350. Multimedia I. 3 Units.
Fundamental concepts and skills for using technology to design, create, express, and present. This project-oriented class will develop knowledge and competencies related to digital imaging, animation, video, multimedia, production and presentation. Offered as ARTS 350 and ARTS 450. Prereq: One from ARTS 101, ARTS 106, ARTS 216, or ARTS 220 or permission of the Director of Art Education.

ARTS 365B. Design and Color. 3 Units.
Advanced design projects determined in consultation with instructor. Prereq: ARTS 101 and ARTS 201.

ARTS 365C. Enameling and Jewelry. 3 Units.
Advanced enameling and jewelry projects determined in consultation with instructor. Prereq: ARTS 210 and ARTS 310.

ARTS 365D. B&W Photography Studio. 3 Units.
Advanced black and white projects determined in consultation with instructor. Prereq: ARTS 220 and ARTS 320.

ARTS 365E. Color Studio. 3 Units.
Advanced digital color studio projects determined in consultation with instructor. Prereq: ARTS 220 and ARTS 322.

ARTS 365G. Ceramics. 3 Units.
Advanced ceramics projects determined in consultation with instructor. Prereq: ARTS 214 and ARTS 314.

ARTS 366A. Student Teaching in Art: Pre-K - 6th Grade. 4 Units.

ARTS 366B. Student Teaching in Art: 7th - 12th Grade. 4 Units.

ARTS 365. Clinical/Field Based Experience I. 1 Unit.
Art education students observe and assist art teachers in classes in a variety of public and private educational environments such as local schools, Cleveland Museum of Art. Students study, identify, and analyze differences in art curriculum taught at the various art programs that they observe. Written reports using departmental observation guidelines are required. Prereq: ARTS 295.

ARTS 386. Clinical/Field Based Experience II. 1 Unit.
Art education students become sensitized to serving needs of “special” populations. Observation of educational strategies for teaching learning disabled and/or physically disabled students. Written reports using departmental observation guidelines required. Prereq: ARTS 295.

ARTS 387. Clinical/Field Based Experience III. 1 Unit.
Art education students observe and assist in art programs for artistically gifted students working in specialized art areas (drawing, painting, sculpture, printmaking, art history). Written reports using departmental observation guidelines are required. Prereq: ARTS 295.

ARTS 393. Art Content, Pedagogy, Methodology, and Assessment. 3 Units.
Growth and development of image making from Pre-K through young adult. Principles and practices of art instruction in grades Pre-K through 12th grade. Issues in art education. Curriculum construction, implementation and assessment of art lessons that address content areas of art production, art history, art appreciation, and art criticism. Clinical field experiences required. Offered as ARTS 393 and ARTS 493. Prereq: ARTS 295.

ARTS 399. Independent Study in Art Studio. 1 - 3 Units.
Independent Study in Art Studio; by permit of Director only.

ARTS 400. Current Issues in Art Education. 3 Units.
Contemporary issues in Art Education; understanding art goals and standards of National Art Education Association and the Ohio State Department of Education for teachers, students and administrators. Special topics: art and technology, multiculturalism, special populations and classroom management. Offered as ARTS 300 and ARTS 400.

ARTS 402. Architecture and City Design I. 3 Units.
The social, spatial, and aesthetic elements in architecture; the components of the building: the window, door, roof, enclosing walls, and character of interior and exterior space. Projects related to small, intimate scale and residential structures. Lectures, field trips, studio experiences. Recommended ARTS 101 or ARTS 106 courses prior to enrollment. Offered as ARTS 302 and ARTS 402.

ARTS 403. Architecture and City Design II. 3 Units.
The social, spatial, and aesthetic elements of the urban setting of architecture, the organizational components of the city, the path, the node, the edge, and the grid. Projects related to large-scale and public buildings and their relationship to the encompassing visual world. Lectures, field trips, studio experiences. Recommended ARTS 101 or ARTS 106 courses prior to enrollment. Offered as ARTS 303 and ARTS 403.
ARTS 405. Study Abroad: Architecture, Design & Culture. 3 Units.
Problem Solving is at the very core of Design, and every city is inventive in its own unique way when it comes to Problem Solving, based on its history, culture, geography and native materials. This intensive international summer course immerses students into a culture that solves architectural problems through a sophisticated appreciation for design, aesthetics and conceptualization. The program introduces students to critical inquiry through the shared principles and theories of Art, Architecture, and Design, as experienced in an international cultural center. Using the city as our classroom, students will visit well-known sites, museums and monuments as well as hidden gems that reinforce the concepts presented in readings and reviewed in class discussions. While no art or drawing skills are required, participants at every level will learn how to improve their visual skills through sketching, observation studies, and analyses. Each week students will complete a design project, each exploring a different aspect of the culture. The course offers Global and Cultural Diversity credit and is open to undergraduate students and graduate students. There is no language requirement for this course. Offered as ARTS 305 and ARTS 405.

ARTS 450. Multimedia I. 3 Units.
Fundamental concepts and skills for using technology to design, create, express, and present. This project-oriented class will develop knowledge and competencies related to digital imaging, animation, video, multimedia, production and presentation. Offered as ARTS 350 and ARTS 450.

ARTS 465. Seminar for Art Teachers. 4 Units.
For art education majors and teacher licensure candidates. Principles and practice in school art instruction grades Pre-K through 12th grade. Organization and management of the art program that incorporates writing sequential art curriculum that integrates art production, art history, appreciation, and criticism. Planning, development, and evaluation of teaching materials, lessons, and units. The seminar includes discussion of professional issues, ethics, art advocacy, and classroom management. Counts as SAGES Senior Capstone. Prereq: ARTS 295 or ARTS 602, and ARTS 393 or ARTS 493. Coreq: ARTS 366A and ARTS 366B or ARTS 466A and ARTS 466B.

ARTS 466A. Student Teaching in Art: Pre-K - 6th Grade. 4 Units.
Teaching art for early childhood, elementary, and middle school students in a school setting. Includes art curriculum development, implementation, and assessment. Professional standards and practices. Offered as ARTS 366A and ARTS 466A. Prereq: ARTS 385, ARTS 386, ARTS 387, ARTS 400, ARTS 493, and ARTS 602. Coreq: ARTS 465 and ARTS 466B.

ARTS 466B. Student Teaching in Art: 7th - 12th Grade. 4 Units.
Teaching adolescents and young adults art in a school setting. Includes art curriculum development, implementation, assessment and classroom management. Professional standards and practices. Offered as ARTS 366B and ARTS 466B. Prereq: ARTS 385, ARTS 386, ARTS 387, ARTS 400, ARTS 493, and ARTS 602. Coreq: ARTS 465 and ARTS 466A.

ARTS 493. Art Content, Pedagogy, Methodology, and Assessment. 3 Units.
Growth and development of image making from Pre-K through young adult. Principles and practices of art instruction in grades Pre-K through 12th grade. Issues in art education. Curriculum construction, implementation and assessment of art lessons that address content areas of art production, art history, art appreciation, and art criticism. Clinical field experiences required. Offered as ARTS 393 and ARTS 493. Prereq: ARTS 602.
The 15 hours in Asia-related courses must be at the 200 or 300 level and come from at least three different departments.

**Minor**

The minor in Asian studies consists of 18 credit hours of Asia-related courses, selected in consultation with the program advisor. Only one year (8 credits) of language study (Japanese or Chinese) counts toward the minor.

The 18 hours in Asia-related courses must be at the 200 or 300 level and come from at least three different departments.

**Honors Program**

Asian Studies Honors is a semester-long program for Asian studies majors, normally taken during the senior year, which involves researching and writing an honors thesis. Honors program requirements include the completion of 12 semester hours of approved Asia-related courses, at least two semesters of study of an Asian language, and maintenance of a GPA of at least 3.0 overall and 3.2 in Asian studies courses.

A participating student enrolls in ASIA 398 Honors Thesis and writes a thesis under the direction of an Asian studies faculty member. The student also receives guidance from a second reader, who must be a member of the Asian Studies Program. A third reader, who need not be a member of the Asian Studies Program, is optional. Each student must maintain regular contact with the supervising faculty member in the various stages of researching and writing the thesis. Detailed guidelines and deadlines for the course are available from the program advisor.

**Courses Available in Asian Studies**

**Language Courses:**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CHIN 101</td>
<td>Elementary Chinese I</td>
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</tr>
<tr>
<td>CHIN 102</td>
<td>Elementary Chinese II</td>
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<tr>
<td>CHIN 201</td>
<td>Intermediate Chinese I</td>
<td>4</td>
</tr>
<tr>
<td>CHIN 202</td>
<td>Intermediate Chinese II</td>
<td>4</td>
</tr>
<tr>
<td>CHIN 203</td>
<td>Intermediate Chinese III</td>
<td>4</td>
</tr>
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<td>CHIN 240</td>
<td>Modern Chinese Literature in Translation</td>
<td>3</td>
</tr>
<tr>
<td>CHIN 250</td>
<td>Classical Chinese Literature in Translation</td>
<td>3</td>
</tr>
<tr>
<td>CHIN 301</td>
<td>Advanced Chinese I</td>
<td>4</td>
</tr>
<tr>
<td>CHIN 302</td>
<td>Advanced Chinese II</td>
<td>4</td>
</tr>
<tr>
<td>CHIN 315</td>
<td>Business Chinese</td>
<td>3</td>
</tr>
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<td>CHIN 320</td>
<td>Chinese Popular Culture</td>
<td>3</td>
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<tr>
<td>CHIN 330</td>
<td>Chinese Cinema</td>
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<td>CHIN 380</td>
<td>Contemporary Chinese Texts</td>
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<tr>
<td>CHIN 399</td>
<td>Independent Study</td>
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<tr>
<td>CHIN 415</td>
<td>Business Chinese</td>
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<tr>
<td>JAPN 101</td>
<td>Elementary Japanese I</td>
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<tr>
<td>JAPN 102</td>
<td>Elementary Japanese II</td>
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<td>JAPN 201</td>
<td>Intermediate Japanese I</td>
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<td>JAPN 202</td>
<td>Intermediate Japanese II</td>
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<td>JAPN 225</td>
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<td>JAPN 245</td>
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**Asian Studies Program**

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<tr>
<th>Course No.</th>
<th>Course Title</th>
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<tr>
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<tr>
<td>JAPN 302</td>
<td>Advanced Japanese II</td>
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</tr>
<tr>
<td>JAPN 345</td>
<td>Japanese Women Writers</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 350</td>
<td>Contemporary Japanese Texts I</td>
<td>3</td>
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<td>JAPN 351</td>
<td>Contemporary Japanese Texts II</td>
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<tr>
<td>JAPN 355</td>
<td>Modern Japanese Novels and the West</td>
<td>3</td>
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<tr>
<td>JAPN 397</td>
<td>Senior Thesis I</td>
<td>3</td>
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<tr>
<td>JAPN 398</td>
<td>Senior Thesis II</td>
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<td>JAPN 399</td>
<td>Independent Study</td>
<td>1 - 3</td>
</tr>
<tr>
<td>JAPN 450</td>
<td>Japanese in Cultural Context I</td>
<td>3</td>
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<tr>
<td>JAPN 451</td>
<td>Japanese in Cultural Context II</td>
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**Anthropology:**

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<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ANTH 312</td>
<td>Ethnography of Southeast Asia</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 331</td>
<td>The Most Ancient Near East</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 333</td>
<td>Roots of Ancient India: Archaeology of South Asia</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 353</td>
<td>Chinese Culture and Society</td>
<td>3</td>
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<tr>
<td>ANTH 354</td>
<td>Health and Healing in East Asia</td>
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**Asia:**

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<td>ASIA 240</td>
<td>Modern Chinese Literature in Translation</td>
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<tr>
<td>ASIA 250</td>
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<td>ASIA 288</td>
<td>Imperial China: The Great Qing</td>
<td>3</td>
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<tr>
<td>ASIA 289</td>
<td>Reform, Revolution, Republics: China 1895 to Present</td>
<td>3</td>
</tr>
<tr>
<td>ASIA 320</td>
<td>Chinese Popular Culture</td>
<td>3</td>
</tr>
<tr>
<td>ASIA 330</td>
<td>Chinese Cinema</td>
<td>3</td>
</tr>
<tr>
<td>ASIA 398</td>
<td>Honors Thesis</td>
<td>1 - 4</td>
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<td>ASIA 399</td>
<td>Independent Study</td>
<td>1 - 3</td>
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**Art History:**

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<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>ARTH 203</td>
<td>The Arts of Asia</td>
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<tr>
<td>ARTH 208</td>
<td>Arts of Japan</td>
<td>3</td>
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<tr>
<td>ARTH 302</td>
<td>Buddhist Art in Asia</td>
<td>3</td>
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<tr>
<td>ARTH 307</td>
<td>Arts of China</td>
<td>3</td>
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<tr>
<td>ARTH 341</td>
<td>Issues in the Art of Japan</td>
<td>3</td>
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<tr>
<td>ARTH 342</td>
<td>Issues in Indian and Southeast Asian Art</td>
<td>3</td>
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<tr>
<td>ARTH 398</td>
<td>Independent Study in Art History</td>
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**History:**

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<tr>
<td>HSTY 137</td>
<td>Introduction to Modern South Asia</td>
<td>3</td>
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<td>HSTY 157</td>
<td>Women’s Histories in South Asia</td>
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<tr>
<td>HSTY 288</td>
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<td>HSTY 324</td>
<td>Issues in Indian and Southeast Asian Art</td>
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<td>HSTY 383</td>
<td>Readings in PRC History</td>
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<td>HSTY 385</td>
<td>Readings in Society and Culture in Modern Chinese History</td>
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**Political Science:**

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<th>Credit Hours</th>
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<tbody>
<tr>
<td>POSC 353</td>
<td>Political Thought and Political Change in China</td>
<td>3</td>
</tr>
</tbody>
</table>
Program Advisory Committee

Lihong Shi, PhD
(Tulane University)
Assistant Professor, Department of Anthropology; Director, Asian Studies Program

Ananya Dasgupta, PhD
(University of Pennsylvania)
Assistant Professor, Department of History

William E. Deal, PhD
(Harvard University)
Severance Professor in the History of Religion, Department of Religious Studies; Chair, Department of Cognitive Science

Noelle Giuffrida, PhD
(University of Kansas)
Assistant Professor, Department of Art History and Art

Melvyn C. Goldstein, PhD
(University of Washington)
John Reynolds Harkness Professor, Department of Anthropology; Co-Director, Center for Research on Tibet

Vanessa Hildebrand, PhD
(Washington University, St. Louis)
Assistant Professor, Department of Anthropology

Kelly M. McMann, PhD
(University of Michigan)
Professor, Department of Political Science

Paul Schroeder, PhD
(Ohio State University)
Visiting Assistant Professor, Department of Political Science

Jonathan Tan, PhD
(The Catholic University of America)
Archbishop Paul J. Hallinan Professor in Catholic Studies; Associate Professor, Department of Religious Studies

Courses

ASIA 132. Introduction to Modern East Asia. 3 Units.
HSTY 132 is an introduction to the histories of modern China, Japan, Korea, and Vietnam from the “dawn of the global world” in the 17th century to present. Taken together these regions make up the geographic and cultural unit commonly referred to as “East Asia.” Over the course of the term, we will investigate the usefulness of this concept of “East Asia” by examining its origins as well as the sometimes convergent, sometimes divergent relations between this region and the rest of the world. We will also challenge the stereotype of a monolithic and static East Asia and see to develop a critical understanding of the internal and external forces integrating and dividing this region. We will examine how international diplomatic, commercial, military, religious, and cultural relationships shaped the individual countries as well as their relationships with each other and the world. The course sweeps over large regions of time and space. It aims to put the contemporary discussion of globalization into historical perspective by examining the long-lasting interactions of East Asian countries with each other and the rest of the world. These connections were economic, political, cultural, and psychological. Topics include: global silver and trade flows, warfare and military technology, imperial domination and revolutionary resistance, and the role of historical memory, as in Nanking or Hiroshima. Sources include historical documents, pictures, films, and memoirs. As we move through the course material our goal is not to gain total knowledge of modern East Asia, nor of China, Japan, Korea nor Vietnam. Rather, by the end of the term you should be able to identify some of the main organizing themes in modern East Asian history and develop a greater understanding of the construction and nature of historical knowledge itself. Offered as HSTY 132 and ASIA 132. Counts for CAS Global & Cultural Diversity Requirement.

ASIA 133. Introduction to Chinese History and Civilization. 3 Units.
This course explains the continuities and discontinuities in the history of China by stressing the development and distinctive adaptations of cultural, religious, and political patterns from the origins of the Chinese civilization to the present. By focusing on major cultural, socioeconomic, and political issues such as Confucianism, Buddhism, trade relations, imperialism, and intellectual discourse in the overall Asian context (with particular reference to Korea and Japan), we discuss the historical development of China and its situation on entering the 21st century. Taking into account the key historical events in the last century, we examine the emergence of China as a modern nation-state and the fundamental transformation of Chinese society in the postwar period. Offered as ASIA 133 and HSTY 133.

ASIA 235. Asian Cinema and Drama. 3 Units.
Introduction to major Asian film directors and major traditional theatrical schools of India, Java/Bali, China, and Japan. Focus on the influence of traditional dramatic forms on contemporary film directors. Development of skills in cross-cultural analysis and comparative aesthetics. Offered as ASIA 235 and WLIT 235.
ASIA 240. Modern Chinese Literature in Translation. 3 Units.
This course examines Modern Chinese Literature from the beginning of the 20th century to contemporary period in the contexts of Chinese historical and cultural transformations. It examines representative works of the major literary genres, including fiction, poetry, drama, and prose writing. We will be making the following inquiries: What is modern Chinese literature? What does it tell us about the cultural, social, psychological, and historical changes that occurred in modern China? Who are the main literary and cultural figures, and what did they contribute to the construction of the Chinese nation? How did Western thoughts impact on the ways in which Chinese reflected on their own cultural identities and social and gender relationships? This course is taught in English. Offered as CHIN 240, ASIA 240 and WLIT 240. Counts for CAS Global & Cultural Diversity Requirement.

ASIA 250. Classical Chinese Literature in Translation. 3 Units.
This course is a survey of the classical Chinese literature from the pre-Qin Period to the fall of Qing Dynasty in 1911. Students will be introduced to a variety of forms and genres, including classical poetry, lyric, aria, elegy, rhapsody, folk song, narrative verse, parallel prose, classical-language short story, vernacular short story, novel, drama, etc. This course is taught in English. Offered as CHIN 250, ASIA 250 and WLIT 250. Counts for CAS Global & Cultural Diversity Requirement.

ASIA 288. Imperial China: The Great Qing. 3 Units.
This course is an introduction to the history of Imperial China, from the fall of the Ming Dynasty in 1644 to the creation of the Chinese republic in 1912. We will explore the major historical transformations (political, economic, social, and cultural) of the last imperial dynasty, the Qing (1644-1911), and develop an understanding of the major social, political, economic, and intellectual cultural forces shaping the formation of modern China. Contrary to commonly-held ideas in both West and in China that traditional Chinese society was timeless or stagnant, historians now see dramatic and significant changes during this period— to the economy, to gender relations, to religion, and to many other aspects of life. This course surveys the social, political, economic, and cultural history of this era, with emphasis on recent research. The main goals of the course will be to acquaint students with the key changes and to show the interplay between economic, social, and cultural changes on the one hand and political developments on the other. By the end of the semester you should have a good sense of how Chinese society was transformed over the course of the 17th through early 20th centuries. The topics we will discuss include urbanization and commerce; gender, family and kinship; education and the examination system; opium and free trade; and ethnicity and nationalism. Offered as ASIA 288 and HSTY 288. Counts for CAS Global & Cultural Diversity Requirement.

ASIA 289. Reform, Revolution, Republics: China 1895 to Present. 3 Units.
Completes a two-term sequence of the Chinese history survey, although HSTY 288 is not a prerequisite for this course. Beginning with the First Sino-Japanese War (1895), we review the historical development of intellectual discourse, public reaction, and political protest in later Imperial China through the creation of the People's Republic in 1949 forward to contemporary times. In contrast to the conventional description of China from a Western point of view, this course tries to explain the emergence of modern China in the context of its intellectual, political, and socio-economic transformation as experienced by Chinese in the late 19th and into the 20th century. By discussing the influence of the West, domestic rebellions, and political radicalism, we examine how the Chinese state and society interacted in search for modernization and reforms, how these reforms were continued during the Republican period, and to what extent historical patterns can be identified in China's present-day development. Offered as ASIA 289 and HSTY 289. Counts for CAS Global & Cultural Diversity Requirement.

ASIA 320. Chinese Popular Culture. 3 Units.
In this course we are going to study Chinese (including Mainland China, Hong Kong, Taiwan, and Chinese Diaspora) popular culture since the 1980s. By examining different forms of popular culture, including popular literature, film, music, TV programs, posters, the Internet, etc., we will be looking into their political, ideological, sociological, cultural, and psychological mechanisms. The film viewing will take place outside the class. Offered as: CHIN 320, ASIA 320 and WLIT 320. Counts for CAS Global & Cultural Diversity Requirement.

ASIA 330. Chinese Cinema. 3 Units.
This course is an exploration to the history of and critical issues in Chinese cinema: we will discuss early film making in Shanghai, leftist melodrama, Socialist films, the Chinese New Wave, underground films, the film making in the era of globalization, and etc. Themes and genres that will be investigated include melodrama, the "Fifth Generation", underground film making, filmic representations of women, minority films, and historical epics. Films from mainland China, Hong Kong, Taiwan, and diasporic communities will be discussed to illuminate what it means to be "Chinese." All of the films in this course come with English subtitles; the film viewing will take place outside the class. Offered as CHIN 330 and ASIA 330. Counts for CAS Global & Cultural Diversity Requirement.

ASIA 398. Honors Thesis. 1 - 4 Units.
Intensive study of a topic or problem under the direction of a faculty member, resulting in the preparation of an honors thesis.

ASIA 399. Independent Study. 1 - 3 Units.
Tutorial in Asian Studies.

Department of Astronomy

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http://astronomy.case.edu/
Phone: 216.368.3278
Stacy S. McGaugh, Department Chair
dept@astroweb.case.edu

The Department of Astronomy offers two undergraduate degrees, a Bachelor of Science and a Bachelor of Arts. The BS provides a rigorous sequence of subject-specific courses, while the BA degree provides somewhat more flexibility in the choice of courses. The department also offers a minor in astronomy.

The curriculum emphasizes a broad and substantial education in astronomy, physics, and mathematics. A faculty actively engaged
in research provides first-rate instruction and opportunities for undergraduate involvement in research.

A bachelor's degree in astronomy can prepare students for graduate study in astronomy (about 50% of our graduates take this path), but those who seek employment in other fields can fill the same jobs as physics and computer science majors.

The department offers a graduate program leading to the degree of Doctor of Philosophy in astronomy. Current research provides opportunities in observational and theoretical studies of galaxy formation and evolution, galaxy cluster evolution, astronomical instrumentation, and cosmology.

Facilities

The Department of Astronomy operates the Kitt Peak Station of the Warner and Swasey Observatory near Tucson, Ariz., home of the Burrell Schmidt telescope. This telescope is used for surveys and ultra-deep imaging with a large format CCD. Observatory operations are managed by Dr. Paul Harding and Charles Knox. Dr. Harding also leads departmental efforts in instrumentation for the Observatory.

On the Case Western Reserve campus, a 9.5-inch refractor permanently mounted on the roof of the A. W. Smith Building is available for use by students. The department also houses a research and instruction computer laboratory and has access to the university's high-performance computing cluster.

Bachelor of Science in Astronomy

The Bachelor of Science in astronomy requires 122 credit hours, including 20 hours in astronomy, 43 hours in physics, 14 hours in math, and 12 hours in technical electives.

Major courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ASTR 221</td>
<td>Stars and Planets</td>
<td>3</td>
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<tr>
<td>ASTR 222</td>
<td>Galaxies and Cosmology</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 306</td>
<td>Astronomical Techniques</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 309</td>
<td>Astrophysics Seminar I</td>
<td>1</td>
</tr>
<tr>
<td>ASTR 310</td>
<td>Astrophysics Seminar II</td>
<td>1</td>
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<tr>
<td>ASTR 311</td>
<td>Stellar Physics</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 323</td>
<td>The Local Universe</td>
<td>3</td>
</tr>
<tr>
<td>ASTR 328</td>
<td>Cosmology and the Structure of the Universe</td>
<td>3</td>
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Additional required courses

<table>
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<tr>
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<td>MATH 121</td>
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<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
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<td>MATH 223</td>
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<td>or MATH 227</td>
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<td>MATH 224</td>
<td>Elementary Differential Equations</td>
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<tr>
<td>or MATH 228</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
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<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
<td>4</td>
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<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 203</td>
<td>Analog and Digital Electronics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 204</td>
<td>Advanced Instrumentation Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
<td>3</td>
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<tr>
<td>PHYS 310</td>
<td>Classical Mechanics</td>
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<tr>
<td>PHYS 313</td>
<td>Thermodynamics and Statistical Mechanics</td>
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<td>PHYS 324</td>
<td>Electricity and Magnetism I</td>
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<td>PHYS 325</td>
<td>Electricity and Magnetism II</td>
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<tr>
<td>PHYS 326</td>
<td>Physical Optics</td>
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<td>PHYS 331</td>
<td>Introduction to Quantum Mechanics I</td>
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<tr>
<td>PHYS 332</td>
<td>Introduction to Quantum Mechanics II</td>
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</table>

Six hours of mathematics and natural science (physics) are double counted towards the SAGES breadth requirements, and one required math course is double counted towards the SAGES Quantitative Reasoning requirement.

Sample Plan of Study: Bachelor of Science in Astronomy

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
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<td>General Physics I - Mechanics (PHYS 121)</td>
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<tr>
<td>SAGES First Seminar</td>
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<tr>
<td>Social Science I</td>
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<tr>
<td>Calculus for Science and Engineering II (MATH 122) or Calculus II (MATH 124)</td>
<td>4</td>
</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)</td>
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<tr>
<td>PHED (2 half semester courses)</td>
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<tr>
<td>Elementary Computer Programming (ENGR 131)</td>
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<tr>
<td>Doing Astronomy (ASTR 151)</td>
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<td>Arts &amp; Humanities I</td>
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Year Total: 89

Calculus for Science and Engineering I (MATH 121) is double counted towards the SAGES breadth requirements, and one required math course is double counted towards the SAGES Quantitative Reasoning requirement.
Second Year

<table>
<thead>
<tr>
<th>Units</th>
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<th>Spring</th>
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<tr>
<td>Stars and Planets (ASTR 221)</td>
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<tr>
<td>Calculus for Science and Engineering III (MATH 223) or Calculus III (MATH 227)</td>
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<td>Introduction to Modern Physics (PHYS 221)</td>
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<tr>
<td>Analog and Digital Electronics (PHYS 203)</td>
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<tr>
<td>SAGES University Seminar</td>
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<tr>
<td>Galaxies and Cosmology (ASTR 222)</td>
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<tr>
<td>Elementary Differential Equations (MATH 224) or Differential Equations (MATH 228)</td>
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<tr>
<td>Advanced Instrumentation Laboratory (PHYS 204)</td>
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<td>Computational Methods in Physics (PHYS 250)</td>
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<tr>
<td>SAGES University Seminar</td>
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<td>Year Total:</td>
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Third Year

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>Stellar Physics (ASTR 311)</td>
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<td>Thermodynamics and Statistical Mechanics (PHYS 313)</td>
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<tr>
<td>Technical Elective</td>
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<tr>
<td>Arts &amp; Humanities II</td>
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<tr>
<td>Social Science II</td>
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<tr>
<td>Cosmology and the Structure of the Universe (ASTR 328)</td>
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<td>Electricity and Magnetism I (PHYS 324)</td>
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<td>Physical Optics (PHYS 326)</td>
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<td>Quantitative Reasoning</td>
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Fourth Year

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<th>Units</th>
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<tr>
<td>Astronomical Techniques (ASTR 306)</td>
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<tr>
<td>Astrophysics Seminar I (ASTR 309)</td>
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<td>Electricity and Magnetism II (PHYS 325)</td>
<td>3</td>
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</tr>
<tr>
<td>Introduction to Quantum Mechanics I (PHYS 331)</td>
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<td></td>
</tr>
<tr>
<td>Astronomy Capstone Project (ASTR 351)</td>
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<td>Technical Elective</td>
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<td>The Local Universe (ASTR 323)</td>
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<tr>
<td>Astrophysics Seminar II (ASTR 310)</td>
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<tr>
<td>Introduction to Quantum Mechanics II (PHYS 332)</td>
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<tr>
<td>Astronomy Capstone Project (ASTR 351)</td>
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<td>Technical Elective</td>
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<tr>
<td>Global and Cultural Diversity</td>
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<td>Year Total:</td>
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</table>

Bachelor of Arts in Astronomy

The Bachelor of Arts in astronomy requires 120 credit hours, including 17 hours in astronomy, 29 hours in physics, 14 hours in math, 3 hours in computer programming, and 6 hours in technical electives.

Required 200 Level Courses

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
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<tbody>
<tr>
<td>ASTR 221</td>
<td>Stars and Planets</td>
</tr>
<tr>
<td>ASTR 222</td>
<td>Galaxies and Cosmology</td>
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Required 300 Level Courses

<table>
<thead>
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<th>Unit</th>
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<tbody>
<tr>
<td>ASTR 309</td>
<td>Astrophysics Seminar I</td>
</tr>
<tr>
<td>ASTR 310</td>
<td>Astrophysics Seminar II</td>
</tr>
<tr>
<td>ASTR 306</td>
<td>Astronomical Techniques</td>
</tr>
<tr>
<td>ASTR 311</td>
<td>Stellar Physics</td>
</tr>
<tr>
<td>ASTR 323</td>
<td>The Local Universe</td>
</tr>
<tr>
<td>ASTR 328</td>
<td>Cosmology and the Structure of the Universe (Additional required courses)</td>
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Additional required courses

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
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<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
</tr>
<tr>
<td>or MATH 124</td>
<td>Calculus II</td>
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<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
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<td>Calculus III</td>
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<tr>
<td>MATH 224</td>
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<td>or MATH 228</td>
<td>Differential Equations</td>
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<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
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<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
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<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
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<tr>
<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
</tr>
</tbody>
</table>

* Suggested, but not required for the major.
### Sample Plan of Study: Bachelor of Arts in Astronomy

#### First Year

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<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
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<td>General Physics I - Mechanics (PHYS 121)</td>
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<tr>
<td>SAGES First Seminar</td>
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<tr>
<td>Social Science I</td>
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<td>Calculus for Science and Engineering II (MATH 122) or Calculus II (MATH 124)</td>
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<td>General Physics II - Electricity and Magnetism (PHYS 122)</td>
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#### Second Year

<table>
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<tr>
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<tr>
<td>Stars and Planets (ASTR 221)</td>
<td>3</td>
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<td>Calculus for Science and Engineering III (MATH 223) or Calculus III (MATH 227)</td>
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<td>Introduction to Modern Physics (PHYS 221)</td>
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<td>SAGES University Seminar</td>
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<tr>
<td>Galaxies and Cosmology (ASTR 222)</td>
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<td>Elementary Differential Equations (MATH 224) or Differential Equations (MATH 228)</td>
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<td>Computational Methods in Physics (PHYS 250)</td>
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<td>Classical Mechanics (PHYS 310)</td>
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</table>

#### SAGES University Seminar | 3    |

| Year Total: | 12   | 15 |

#### Third Year

<table>
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<th>Units</th>
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<tbody>
<tr>
<td>Stellar Physics (ASTR 311)*</td>
<td>3</td>
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<tr>
<td>Thermodynamics and Statistical Mechanics (PHYS 313)</td>
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<tr>
<td>Arts &amp; Humanities I</td>
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<tr>
<td>Arts &amp; Humanities II</td>
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<tr>
<td>Technical Elective</td>
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<tr>
<td>Cosmology and the Structure of the Universe (ASTR 328)*</td>
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<td></td>
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<tr>
<td>Electricity and Magnetism I (PHYS 324)</td>
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<tr>
<td>Physical Optics (PHYS 326)</td>
<td>3</td>
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<tr>
<td>Quantitative Reasoning</td>
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#### Fourth Year

<table>
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<tr>
<th>Units</th>
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<tbody>
<tr>
<td>Astronomical Techniques (ASTR 306)*</td>
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<td></td>
</tr>
<tr>
<td>Astrophysics Seminar I (ASTR 309)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Introduction to Quantum Mechanics I (PHYS 331)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Astronomy Capstone Project (ASTR 351)*</td>
<td>1 - 3</td>
<td></td>
</tr>
<tr>
<td>Global and Cultural Diversity</td>
<td>3</td>
<td></td>
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<tr>
<td>Astrophysics Seminar II (ASTR 310)</td>
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<tr>
<td>Astronomy Capstone Project (ASTR 351)</td>
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<tr>
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<td>2-4</td>
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#### Total Units in Sequence: 100-104

\* 300-level astronomy courses: three of the following four are required: ASTR 306, ASTR 311, ASTR 323, ASTR 328.

\* A SAGES Capstone Experience is required of all students. The BA in astronomy does not require the astronomy capstone but only that a capstone be taken. The number of hours shown assumes the astronomy capstone with 1 hour in the senior fall semester and 3 hours in the senior spring semester. If another capstone is taken, the number of hours may be different.

\* Suggested, but not required for the major.

### Minor in Astronomy

The requirements for the minor in astronomy are as follows:

- One of the following:
  - PHYS 115 Introductory Physics I
  - PHYS 121 General Physics I - Mechanics
  - PHYS 123 Physics and Frontiers I - Mechanics

- One of the following:
  - PHYS 116 Introductory Physics II
  - PHYS 122 General Physics II - Electricity and Magnetism
Graduate Program

The PhD degree in astronomy is granted to those students who have shown an extensive knowledge of advanced astronomy and the ability to do original research. The student is required to pass a general qualifying examination in astronomy, usually taken at the end of the second year. The student must then prepare a dissertation based on the results of independent research. A PhD candidate must also satisfy the general requirements of the School of Graduate Studies.

Full-time graduate students who maintain satisfactory academic performance while pursuing the PhD degree in astronomy normally receive a stipend for teaching and/or research, which includes full tuition and a monthly amount sufficient to cover living expenses.

Department Faculty

Stacy S. McGaugh, PhD
(University of Michigan)
Professor and Chair; director, Warner and Swasey Observatory
Galaxy formation and evolution; low surface brightness galaxies; cosmology; dark matter and gravity

R. Earle Luck, PhD
(University of Texas, Austin)
Worcester R. and Cornelia B. Warner Professor of Astronomy
Stellar and galactic chemical evolution; stellar spectrophotometry

J. Christopher Mihos, PhD
(University of Michigan)
Professor
Galaxy evolution; interacting and merging galaxies; galaxy clusters; computational and observational astronomy

Heather L. Morrison, PhD
(Australian National University)
Professor
Galaxy formation via observational studies of the Milky Way and nearby galaxies; dark matter

Idit Zehavi, PhD
(Racah Institute of Physics, Hebrew University of Jerusalem)
Associate Professor
Cosmology and large-scale structure; structure formation; clustering of galaxies; cosmic flows

Adjunct Faculty

Jeffery R. Kriessler, PhD
(Michigan State University)
Adjunct Assistant Professor
Substructure in galaxy clusters

Secondary Faculty

John Ruhl, PhD
(Princeton University)
Connecticut Professor, Department of Physics
Experimental astrophysics and cosmology

Glenn D. Starkman, PhD
(Stanford University)
Distinguished University Professor, Department of Physics
Theoretical cosmology; particle physics; astrophysics

Courses

ASTR 151. Doing Astronomy. 1 Unit.
This course is intended to introduce students to how astronomy is done. The course will focus on the astronomical research process, the scientific community, and on career paths in astronomy. Course activities will include readings and class discussions focusing on various topics in modern astronomy, including ongoing research activity in the department. This course is largely intended for first- and second-year students considering majoring or minoring in astronomy, or pursuing a career in astronomy. Prereq: First- or second-year academic standing.

ASTR 201. The Sun and its Planets. 3 Units.
An overview of the solar system; the planets and other objects that orbit about the Sun and the Sun itself as the dominant mass and the most important source of energy in the solar system. Concepts and the development of our knowledge will be emphasized. Not available for credit to astronomy majors.

ASTR 202. Stars, Galaxies, and the Universe. 3 Units.
Stellar structure, energy sources, and evolution, including red giants, white dwarfs, supernovae, pulsars, and black holes. Stellar populations in the Milky Way and external galaxies. The universe and its evolution. Not available for credit to astronomy majors.

ASTR 204. Einstein's Universe. 3 Units.
This course is intended to introduce the non-scientist to the concepts of modern cosmology—the structure and evolution of the universe. No mathematical background beyond simple algebra is needed.

ASTR 206. Life in the Universe. 3 Units.
This course is intended to introduce the non-scientist to the field of astrobiology—the interdisciplinary study of, and the search for, extraterrestrial life and the conditions for extraterrestrial life in the Universe. We will explore questions such as: How did life begin on Earth? What conditions are necessary for life to survive? What conditions are required for the long-term habitability of the Earth? Can life exist elsewhere in our Galaxy? Students may receive credit for ASTR 206 or USNA 217 (Astrobiology), but not for both.

ASTR 221. Stars and Planets. 3 Units.
ASTR 222. Galaxies and Cosmology. 3 Units.

ASTR 306. Astronomical Techniques. 3 Units.
This course covers the techniques astronomers use to conduct research, including observations using ground- and space-based telescopes, computer simulations and other numerical methods, and statistical data mining of large on-line astronomical datasets. Offered as ASTR 306 and ASTR 406. Counts as SAGES Departmental Seminar. Prereq: ASTR 222.

ASTR 309. Astrophysics Seminar I. 1 Unit.
Selected topics in astronomy not covered ordinarily in courses. Presentation of talks by the students.

ASTR 310. Astrophysics Seminar II. 1 Unit.
Selected topics in astronomy not covered ordinarily in courses. Presentation of talks by students.

ASTR 311. Stellar Physics. 3 Units.
Radiative transfer, atomic and molecular opacities, and the observable properties of stars. Stellar interiors, nuclear processes, and energy generation. The evolution of stars of varying mass and production of the elements within supernovae explosions. Offered as ASTR 311 and ASTR 411. Prereq: ASTR 222.

ASTR 323. The Local Universe. 3 Units.

ASTR 328. Cosmology and the Structure of the Universe. 3 Units.

ASTR 333. Dark Matter. 3 Units.
This course will systematically explore the evidence for dark matter in the universe. Necessary physical theory and astronomical concepts will be developed as appropriate. Topics to be covered include gravitational dynamics, gravitational lensing, and hydrostatic equilibrium as probes of the gravitational potentials of extragalactic systems. Examples include the rotation curves of spiral galaxies, the Oort discrepancy in the local Galactic disk, the dynamics of pressure supported dwarf and giant elliptical galaxies, and the Local Group timing problem. In clusters of galaxies, the mass discrepancy is illustrated separately by measured velocity dispersions, the hydrostatic equilibrium of the hot intracluster medium, and both strong and weak gravitational lensing. On cosmic scales, the course will address evidence from the gravitating and baryonic mass content of the universe, the growth of large scale structure from the initially smooth cosmic microwave background, and the existence of large voids and large scale bulk flows. The course will describe the various dark matter halo models commonly employed and introduce the techniques of mass modeling. We will examine hypotheses for the nature of dark matter, both baryonic and non-baryonic, and discuss strategies for experimental detection of plausible dark matter candidates. Theories that seek to explain the observed mass discrepancies by means of modifying the Law of Gravity rather than invoking dark matter will be explored. Offered as ASTR 333 and ASTR 433. Prereq: PHYS 310 or requisites not met permission.

ASTR 351. Astronomy Capstone Project. 1 - 3 Units.
A two semester course (1 hour in the Fall Semester and either 2 or 3 hours in the Spring Semester) for students desiring a Capstone Experience in astronomy. Students pursue a project based on experimental, theoretical or teaching research under the supervision of an astronomy faculty member. A departmental Capstone Project Committee must approve all project proposals (by the end of the Fall Semester) and this same committee will receive regular oral and written progress reports. Final results are presented at the end of the semester as a paper in a style suitable for publication in a professional journal as well as an oral report in a public symposium. Counts as SAGES Senior Capstone. Prereq: ASTR 222.

ASTR 369. Undergraduate Research. 1 - 3 Units.
Supervised research on topics of interest. Can be used as a thesis course if desired. Students may register more than once for a maximum of 9 credits overall (1-3 credits each semester).

ASTR 396. Special Topics in Astronomy. 1 - 3 Units.
Open to astronomy majors only.

ASTR 406. Astronomical Techniques. 3 Units.
This course covers the techniques astronomers use to conduct research, including observations using ground- and space-based telescopes, computer simulations and other numerical methods, and statistical data mining of large on-line astronomical datasets. Offered as ASTR 306 and ASTR 406. Counts as SAGES Departmental Seminar.

ASTR 411. Stellar Physics. 3 Units.
Radiative transfer, atomic and molecular opacities, and the observable properties of stars. Stellar interiors, nuclear processes, and energy generation. The evolution of stars of varying mass and production of the elements within supernovae explosions. Offered as ASTR 311 and ASTR 411.

ASTR 423. The Local Universe. 3 Units.

ASTR 428. Cosmology and the Structure of the Universe. 3 Units.
ASTR 433. Dark Matter. 3 Units.
This course will systematically explore the evidence for dark matter in the universe. Necessary physical theory and astronomical concepts will be developed as appropriate. Topics to be covered include gravitational dynamics, gravitational lensing, and hydrostatic equilibrium as probes of the gravitational potentials of extragalactic systems. Examples include the rotation curves of spiral galaxies, the Oort discrepancy in the local Galactic disk, the dynamics of pressure supported dwarf and giant elliptical galaxies, and the Local Group timing problem. In clusters of galaxies, the mass discrepancy is illustrated separately by measured velocity dispersions, the hydrostatic equilibrium of the hot intracluster medium, and both strong and weak gravitational lensing. On cosmic scales, the course will address evidence from the gravitating and baryonic mass content of the universe, the growth of large scale structure from the initially smooth cosmic microwave background, and the existence of large voids and large scale bulk flows. The course will describe the various dark matter halo models commonly employed and introduce the techniques of mass modeling. We will examine hypotheses for the nature of dark matter, both baryonic and non-baryonic, and discuss strategies for experimental detection of plausible dark matter candidates. Theories that seek to explain the observed mass discrepancies by means of modifying the Law of Gravity rather than invoking dark matter will be explored. Offered as ASTR 333 and ASTR 433.

ASTR 497. Special Topics in Astronomy. 1 - 3 Units.

ASTR 601. Research. 1 - 18 Units.
Original research under the guidance of the staff.

ASTR 651. Thesis M.S.. 1 - 18 Units.
(Credit as arranged.)

ASTR 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Biochemistry

The College of Arts and Sciences awards the Bachelor of Arts and Bachelor of Science degrees in biochemistry. The required courses for the majors and minor are offered by the Department of Biochemistry in the School of Medicine.

Major

The two undergraduate major programs in Biochemistry, BA and BS, are based on the Arts and Sciences General Education Requirements, but differ in amount and intensity of the mathematics and physical sciences required. Either degree is excellent for students planning to undertake graduate work in biochemistry or in related areas of the biomedical sciences. Both the BA and the BS programs permit students to follow many options after graduation. Graduates are well prepared to pursue further studies in the biological sciences, for a career in medicine, for Doctor of Pharmacy programs, for employment in the chemical, pharmaceutical, and biotechnology industries, or as research assistants in research laboratories. The BA has a reduced emphasis on the quantitative aspects of science and makes available a considerable amount of elective time that permits a student to either concentrate on biochemistry even more intensively than the curriculum requires, or pursue other subjects in science or liberal arts. The BS degree is for the student who has a particularly strong interest in the quantitative physical sciences.

In both programs, undergraduate research is required. As many as nine hours of Research in Biochemistry (BIOC 391 Research Project) may be credited toward the requirements for graduation. The capstone in Biochemistry (BIOC 393 Senior Capstone Experience) is a thesis and presentation of a student’s undergraduate research studies.

Bachelor of Arts in Biochemistry

Required Courses:

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 308</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 373</td>
<td>Biochemistry SAGES Seminar (SAGES Departmental Seminar)</td>
<td>3</td>
</tr>
<tr>
<td>Biochemistry elective:</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>BIOC 312 or BIOC 334</td>
<td>Proteins and Enzymes Structural Biology</td>
<td></td>
</tr>
<tr>
<td>Two approved technical electives in biochemistry</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>BIOC 393</td>
<td>Senior Capstone Experience</td>
<td>3</td>
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<td>Additional Required Courses:</td>
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<td>BIOL 214 &amp; 214L</td>
<td>Genes, Evolution and Ecology and Genes, Evolution and Ecology Lab</td>
<td>4</td>
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<tr>
<td>BIOL 215 &amp; 215L</td>
<td>Cells and Proteins and Cells and Proteins Laboratory</td>
<td>4</td>
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<td>CHEM 105 or CHEM 111</td>
<td>Principles of Chemistry I Principles of Chemistry for Engineers</td>
<td>3-4</td>
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<tr>
<td>CHEM 106 or ENGR 145</td>
<td>Principles of Chemistry II Chemistry of Materials</td>
<td>3-4</td>
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<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
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<tr>
<td>CHEM 223 or CHEM 323</td>
<td>Introductory Organic Chemistry I Organic Chemistry I</td>
<td>3</td>
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<td>CHEM 224 or CHEM 324</td>
<td>Introductory Organic Chemistry II Organic Chemistry II</td>
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<td>CHEM 233</td>
<td>Introductory Organic Chemistry Laboratory I</td>
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<td>Introductory Organic Chemistry Laboratory II</td>
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<td>CHEM 301</td>
<td>Introductory Physical Chemistry I</td>
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<td>MATH 125 or MATH 121</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I Calculus for Science and Engineering I</td>
<td>4</td>
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<td>PHYS 115 or PHYS 121</td>
<td>Introductory Physics I General Physics I - Mechanics</td>
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<td>PHYS 116 or PHYS 122</td>
<td>Introductory Physics II General Physics II - Electricity and Magnetism</td>
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Total Units: 66-68

BA Biochemistry, Sample Plan of Study

Freshman

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<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I (MATH 125)</td>
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### Sophomore

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<tr>
<td>Introductory Organic Chemistry I (CHEM 223)</td>
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<td>Introductory Organic Chemistry Laboratory I (CHEM 233)</td>
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<tr>
<td>Introductory Physics I (PHYS 115)</td>
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<tr>
<td>GER Course</td>
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<tr>
<td>Introductory Organic Chemistry II (CHEM 224)</td>
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<td>Introductory Organic Chemistry Laboratory II (CHEM 234)</td>
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<tr>
<td>Introductory Physics II (PHYS 116)</td>
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<td>GER Course</td>
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### Junior

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<tbody>
<tr>
<td>Introductory Physical Chemistry I (CHEM 301)</td>
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<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 307)</td>
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<td>GER Course</td>
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<tr>
<td>Electives</td>
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<td>Molecular Biology (BIOC 308)</td>
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<td>Approved Technical Elective(^a)</td>
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<tr>
<td>Research Project (BIOC 391)</td>
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<td>Electives</td>
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### Senior

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<tbody>
<tr>
<td>Biochemistry SAGES Seminar (BIOC 373)</td>
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<tr>
<td>Research Project (BIOC 391)</td>
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<tr>
<td>Approved Biochemistry or Technical Elective(^b)</td>
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<td>Electives</td>
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<tr>
<td>Senior Capstone Experience (BIOC 393)</td>
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### Bachelor of Science in Biochemistry

**Required Courses:**

<table>
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<th>Course</th>
<th>Units</th>
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<tr>
<td>BIOC 307 Introduction to Biochemistry: From Molecules To Medical Science</td>
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<tr>
<td>BIOC 308 Molecular Biology</td>
<td>4</td>
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<tr>
<td>BIOC 312 Proteins and Enzymes</td>
<td>3</td>
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<tr>
<td>BIOC 334 Structural Biology</td>
<td>3</td>
</tr>
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<td>BIOC 373 Biochemistry SAGES Seminar</td>
<td>3</td>
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<td>Approved Technical Elective in Biochemistry</td>
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<tr>
<td>BIOC 393 Senior Capstone Experience</td>
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<tr>
<td>BIOC 214 Genes, Evolution and Ecology &amp; Genes, Evolution and Ecology Lab</td>
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<td>BIOC 312 Proteins and Enzymes</td>
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<td>CHEM 105 Principles of Chemistry I</td>
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<td>CHEM 106 Principles of Chemistry for Engineers</td>
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<td>CHEM 301 Principles of Chemistry II</td>
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<td>CHEM 303 Principles of Chemistry Laboratory</td>
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<td>CHEM 323 Introductory Organic Chemistry I</td>
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<td>CHEM 335 Introductory Physical Chemistry I</td>
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<td>CHEM 336 Introductory Physical Chemistry II</td>
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<tr>
<td>MATH 122 Calculus for Science and Engineering II</td>
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</table>

\(^a\) Selected students may be invited to take CHEM 323 Organic Chemistry I, CHEM 324 Organic Chemistry II.

\(^b\) One of the approved electives in Biochemistry taken must be either BIOC 312 Proteins and Enzymes or BIOC 334 Structural Biology.
BS Biochemistry, Sample Plan of Study

**Freshman**

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>MATH 223</td>
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<td>MATH 224</td>
<td>Elementary Differential Equations</td>
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<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
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<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
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<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
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<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
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**Sophomore**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>MATH 227</td>
<td>Calculus III</td>
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<tr>
<td>MATH 228</td>
<td>Differential Equations</td>
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<td>PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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</tr>
<tr>
<td>PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td></td>
</tr>
<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
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<tr>
<td>or equivalent</td>
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<tr>
<td>Total Units</td>
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</table>

Note: At least the 3 credits of undergraduate research, BIOC 391, is a prerequisite to the Capstone. An additional 3 credits of BIOC 391 is highly recommended. Students should consult their academic advisers about the elective parts of the curriculum.

**Honors Program**

Biochemistry majors who have excellent academic records may be admitted to the department's Undergraduate Honors Program. To graduate with departmental honors in biochemistry, a student must satisfy the following requirements:

1. A combined grade point average of at least 3.600
2. A minimum of 6 credit hours of undergraduate research (BIOC 391) in one laboratory
3. A BIOC 393 capstone report approved by the Undergraduate Education Committee of the department on the basis of the quality of the research, the written report, and an oral presentation. An acceptable report:
   a. Should follow a standard journal format
   b. Should demonstrate the student’s understanding of the research area, experimental techniques, goals and implications of the project
   c. Should show that the student has advanced his/her knowledge of the applicable techniques and the underlying scientific concepts.
4. Using all or part of the capstone report, the student must be a co-author on a manuscript either submitted, in press or published in a peer reviewed journal.

**Minor**

**Required Courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 308</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>One of the following:</td>
<td></td>
</tr>
<tr>
<td>BIOC 312</td>
<td>Proteins and Enzymes</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 334</td>
<td>Structural Biology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Approved technical elective in biochemistry</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

Students may obtain credit for a minor in biochemistry by completing one year of freshman chemistry (including laboratory), one year of organic chemistry (including laboratory), two semesters of approved biology courses, and three semesters of didactic courses in biochemistry.

**Department of Biology**

203 DeGrace Hall  
www.case.edu/artsci/biol  
Phone: 216.368.3557; Fax: 216.368.4672  
Mark Willis, Department Chair  
mark.willis@case.edu

The mission of the Department of Biology at Case Western Reserve University is to promote research programs of national and international prominence and to provide strong undergraduate and graduate educational programs that emphasize integrative approaches to biological problems. In doing so, our programs support preparation and professional development for careers related to the biological and health sciences.

The department offers courses leading to the degrees of Bachelor of Science, Bachelor of Science in Systems Biology, Bachelor of Arts, Master of Science, and Doctor of Philosophy. Cooperative programs between the Department of Biology and the Case Western Reserve University School of Medicine, the Cleveland Museum of Natural History, the Cleveland Botanical Garden, the Cleveland Metroparks Zoo, the Holden Arboretum, the Cleveland Institute of Art, and other departments in Case Western Reserve University significantly extend the range of resources available to biology students. The department also operates an extensive field research station at Squire Valleeve Farm, located about 10 miles east of the University. Undergraduate students are encouraged to conduct individual supervised research projects with biology faculty and with faculty in cooperating departments. A supervised research project is required of all students in the BS biology program.

The undergraduate programs in biology provide excellent preparation for graduate or professional schools, including medical, dental, and veterinary schools and the many specialized graduate programs in the biological sciences. A biology degree also prepares students for careers in industry and government. For students interested in biotechnology—a field with growing career opportunities—the department offers elective sequences within the BA and BS degrees.

In addition to formal courses for credit, the department offers weekly seminars during the academic year, presenting recent advances in biology. These seminars are held every Thursday at 4:00 p.m. and are open to the university community.

**Majors**

Major programs share a core of foundation courses and provide options for specialization in a variety of areas, including biotechnology and genetic engineering, molecular and cellular biology, genetics, immunology, chemical biology, physiology and biophysics, neurobiology and animal behavior, developmental biology, population biology, ecology, and environmental science. Theoretical, mathematical, and computational approaches to these fields are emphasized in the Systems Biology BS program. Individual research projects form a significant part of the curriculum for many undergraduates in all programs, and are specifically required for students in the Biology BS program. Advanced biology majors may register, with permission, for graduate-level courses in the department and in the School of Medicine.

The department offers programs leading to the BA and BS degrees. Thirty hours of biology are required for the Biology BA, 39 hours for the Biology BS, and 30 hours for the Systems Biology BS. Ordinarily, all students begin their biology programs in the freshman year. All students must complete the SAGES seminar and General Education Requirements (GER) of the College of Arts and Sciences. While some BIOL courses serve as SAGES Departmental Seminars or SAGES Capstones, none of these are required courses for biology degree candidates, with the specific exception of BIOL 388S Undergraduate Research - SAGES Capstone for the Biology BS degree. A Biology BA student, for example, is free to take a non-BIOL SAGES Departmental Seminar or SAGES Capstone course, assuming that prerequisites are met (or waived by the instructor).

**Bachelor of Arts in Biology**

The Biology BA degree program provides a general background in biology, and has the most flexible scheduling of the three biology degrees offered. It is especially recommended for students who are pre-professional, have multiple majors, intend to do a junior year abroad or an internship program, or have significant extracurricular commitments (e.g., varsity athletics, student government, Greek life, or other campus involvement).

Since the Biology BA degree does not formally require undergraduate research, students interested in graduate research careers should plan to take at least one semester of undergraduate research as an elective (BIOL 388 Undergraduate Research or BIOL 388S Undergraduate Research - SAGES Capstone) sometime during the senior year.
# Biology Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 214L</td>
<td>Genes, Evolution and Ecology Lab</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>Cells and Proteins</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 215L</td>
<td>Cells and Proteins Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 216</td>
<td>Development and Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 216L</td>
<td>Development and Physiology Lab</td>
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</tr>
</tbody>
</table>

# One Genetics Course

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 326</td>
<td>Genetics (effective Fall 2014; previously a cell/molecular elective)</td>
<td>3</td>
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</tbody>
</table>

# One Course from Any Two of the Following Three Subject Areas (Breadth Requirement)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 303</td>
<td>From Blackbox to Toolbox: How Molecular Biology Moves Forward</td>
<td></td>
</tr>
<tr>
<td>BIOL 308</td>
<td>Molecular Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 316</td>
<td>Fundamental Immunology</td>
<td></td>
</tr>
<tr>
<td>BIOL 324</td>
<td>Introduction to Stem Cell Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 325</td>
<td>Cell Biology</td>
<td></td>
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<tr>
<td>BIOL 328</td>
<td>Plant Genomics and Proteomics</td>
<td></td>
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<tr>
<td>BIOL 334</td>
<td>Structural Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 342</td>
<td>Parasitology</td>
<td></td>
</tr>
<tr>
<td>BIOL 343</td>
<td>Microbiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 365</td>
<td>Evo-Devo: Evolution of Body Plans and Pathologies</td>
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</table>

# Organismal Biology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL 223</td>
<td>Vertebrate Biology (organismal elective or lab, not both)</td>
<td></td>
</tr>
<tr>
<td>BIOL 302</td>
<td>Human Learning and the Brain</td>
<td></td>
</tr>
<tr>
<td>BIOL 318</td>
<td>Introductory Entomology (organismal elective or lab, not both)</td>
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<tr>
<td>BIOL 322</td>
<td>Sensory Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 333</td>
<td>The Human Microbiome</td>
<td></td>
</tr>
<tr>
<td>BIOL 338</td>
<td>Ichthyology (effective Spring 2015; organismal elective or lab, not both; previously not a lab)</td>
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</tr>
<tr>
<td>BIOL 340</td>
<td>Human Physiology</td>
<td></td>
</tr>
<tr>
<td>BIOL 346</td>
<td>Human Anatomy</td>
<td></td>
</tr>
<tr>
<td>BIOL 362</td>
<td>Principles of Developmental Biology</td>
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</tr>
<tr>
<td>BIOL 374</td>
<td>Neurobiology of Behavior</td>
<td></td>
</tr>
<tr>
<td>BIOL 379</td>
<td>Transformative Animal Models in Modern Biology</td>
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</tr>
<tr>
<td>BIOL 385</td>
<td>Seminar on Biological Processes in Learning and Cognition</td>
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</table>

# Population Biology and Ecology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 225</td>
<td>Evolution</td>
<td></td>
</tr>
<tr>
<td>BIOL 307</td>
<td>Evolutionary Biology of the Invertebrates</td>
<td></td>
</tr>
<tr>
<td>BIOL 336</td>
<td>Aquatic Biology</td>
<td></td>
</tr>
<tr>
<td>BIOL 351</td>
<td>Principles of Ecology</td>
<td></td>
</tr>
<tr>
<td>BIOL 358</td>
<td>Animal Behavior (population/ ecology elective or lab, not both)</td>
<td></td>
</tr>
</tbody>
</table>

# Mathematics Core Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td></td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
</tbody>
</table>
## Chemistry core courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 323</td>
<td>Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>CHEM 224</td>
<td>Introductory Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 324</td>
<td>Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 233</td>
<td>Introductory Organic Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>Laboratory</td>
<td>I</td>
<td></td>
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</table>

## Physics core courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td></td>
</tr>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td></td>
</tr>
</tbody>
</table>

Total Units: **63-72**

At least 15 hours of the selected electives and additional laboratory courses must be at the 300 level or higher.

### BA Biology, Suggested Sequence of Courses

#### First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genes, Evolution and Ecology (BIOL 214)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Genes, Evolution and Ecology Lab (BIOL 214L)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SAGES First Seminar</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PHED Physical Education</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I (MATH 125)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or Calculus for Science and Engineering I (MATH 121)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry I (CHEM 105)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry Laboratory (CHEM 113)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cells and Proteins (BIOL 215)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cells and Proteins Laboratory (BIOL 215L)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PHED Physical Education</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II (MATH 126)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>or Calculus for Science and Engineering II (MATH 122)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry II (CHEM 106)</td>
<td>3</td>
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<tr>
<td>Year Total:</td>
<td>15</td>
<td>16</td>
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</table>

#### Second Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Organic Chemistry I (CHEM 223)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>or Organic Chemistry I (CHEM 323)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introductory Organic Chemistry Laboratory I (CHEM 233)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GER Course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Development and Physiology (BIOL 216)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Development and Physiology Lab (BIOL 216L)</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

### Third Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genetics (BIOL 326) (or BIOL Elective)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Introductory Organic Chemistry II (CHEM 224)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>or Organic Chemistry II (CHEM 324)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAGES Departmental Seminar</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GER Course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
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<td>15</td>
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</table>

### Fourth Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>or SAGES Capstone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Electives</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>SAGES Capstone</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>or BIOL Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL Elective (if needed)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>or Open Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Electives</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Total Units in Sequence: **121-125**

### Teacher Licensure

Students may become eligible for teacher licensure in the field of Life Sciences (Adolescents and Young Adults) by completing content area requirements as well as 34 semester hours in education courses (including student teaching) offered through CWRU. For more details, please contact James Bader (james.bader@case.edu), executive director of the Gelfand STEM Center.

### Subject Area Requirements

#### Biology core courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 214L</td>
<td>Genes, Evolution and Ecology Lab</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>Cells and Proteins</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 215L</td>
<td>Cells and Proteins Laboratory</td>
<td>1</td>
</tr>
</tbody>
</table>

## Teacher Licensure

Students may become eligible for teacher licensure in the field of Life Sciences (Adolescents and Young Adults) by completing content area requirements as well as 34 semester hours in education courses (including student teaching) offered through CWRU. For more details, please contact James Bader (james.bader@case.edu), executive director of the Gelfand STEM Center.

### Subject Area Requirements

#### Biology core courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 214L</td>
<td>Genes, Evolution and Ecology Lab</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>Cells and Proteins</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 215L</td>
<td>Cells and Proteins Laboratory</td>
<td>1</td>
</tr>
</tbody>
</table>
Bachelor of Science in Biology

The Biology BS degree program is intended to prepare students for work as traditional bench or field research scientists. In addition to a general background in biology (the same as provided by the Biology BA program), the Biology BS program requires two semesters of undergraduate research, plus additional courses in quantitative methods (computer programming, statistics, data analysis) and physical chemistry. The research may be done at the university or at any of its affiliated institutions, but the biology department does not formally place students into laboratories. Because of the extra course work and research requirements, the Biology BS program may present scheduling challenges to students who wish to pursue multiple majors, a junior year abroad or internship, or significant extracurricular activities. Early, careful planning in consultation with the major advisor is essential to stay on schedule.

Biology core courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 214L</td>
<td>Genes, Evolution and Ecology Lab</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>Cells and Proteins</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 215L</td>
<td>Cells and Proteins Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 216</td>
<td>Development and Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 216L</td>
<td>Development and Physiology Lab</td>
<td>1</td>
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</tbody>
</table>

Chemistry core courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
<td>2</td>
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<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 224</td>
<td>Introductory Organic Chemistry II</td>
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</tr>
<tr>
<td>CHEM 233</td>
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</table>

Physics core courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
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</table>

One of the following earth, environmental, and planetary sciences (EEPS) courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPS 101</td>
<td>The Earth and Planets</td>
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</tr>
<tr>
<td>EEPS 110</td>
<td>Physical Geology</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 115</td>
<td>Introduction to Oceanography</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 117</td>
<td>Weather and Climate</td>
<td>3</td>
</tr>
</tbody>
</table>

One of the following genetics, cell and molecular biology, or microbiology courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL 308</td>
<td>Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 326</td>
<td>Genetics</td>
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<tr>
<td>BIOL 343</td>
<td>Microbiology</td>
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<tr>
<td>BIOL 362</td>
<td>Principles of Developmental Biology</td>
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One of the following genetics, cell and molecular biology, or microbiology courses

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<thead>
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<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL 301</td>
<td>Biotechnology Laboratory: Genes and Genetic Engineering</td>
<td>3-4</td>
</tr>
<tr>
<td>BIOL 344</td>
<td>Laboratory for Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 362</td>
<td>Principles of Developmental Biology</td>
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One of the following behavior courses

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>BIOL 358</td>
<td>Animal Behavior</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 373</td>
<td>Introduction to Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 374</td>
<td>Neurobiology of Behavior</td>
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</table>

One of the following zoology or ecology courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>BIOL 305</td>
<td>Herpetology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 318</td>
<td>Introductory Entomology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 336</td>
<td>Aquatic Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 338</td>
<td>Ichthyology</td>
<td>3</td>
</tr>
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<td>BIOL 351</td>
<td>Principles of Ecology</td>
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Total Units: 61-65
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<tr>
<th>Course Code</th>
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<tr>
<td>BIOL 379</td>
<td>Transformative Animal Models in Modern Biology</td>
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<td>BIOL 385</td>
<td>Seminar on Biological Processes in Learning and Cognition</td>
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<tr>
<td>BIOL 225</td>
<td>Evolution</td>
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<td>BIOL 336</td>
<td>Aquatic Biology</td>
</tr>
<tr>
<td>BIOL 351</td>
<td>Principles of Ecology</td>
</tr>
<tr>
<td>BIOL 358</td>
<td>Animal Behavior (population/ecology elective or lab, not both)</td>
</tr>
<tr>
<td>BIOL 364</td>
<td>Research Methods in Evolutionary Biology</td>
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<tr>
<td>BIOL 368</td>
<td>Topics in Evolutionary Biology</td>
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<tr>
<td>BIOL 384</td>
<td>Reading and Writing Like an Ecologist</td>
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<td>BIOL 398</td>
<td>Modern Human Biological Variation</td>
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<tr>
<td>BIOL 300</td>
<td>Dynamics of Biological Systems: A Quantitative Introduction to Biology</td>
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<tr>
<td>BIOL 304</td>
<td>Fitting Models to Data: Maximum Likelihood Methods and Model Selection</td>
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<tr>
<td>BIOL 315</td>
<td>Quantitative Biology Laboratory</td>
</tr>
<tr>
<td>BIOL 321</td>
<td>Design and Analysis of Biological Experiments</td>
</tr>
<tr>
<td>BIOL 327</td>
<td>Functional Genomics</td>
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<tr>
<td>BIOL 352</td>
<td>Ecology and Evolution of Infectious Diseases</td>
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<tr>
<td>BIOL 373</td>
<td>Introduction to Neurobiology (effective Fall 2014; previously an organismal elective)</td>
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<tr>
<td>BIOL 397</td>
<td>Molecular Phylogenetics</td>
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<tr>
<td>BIOL 300</td>
<td>Dynamics of Biological Systems: A Quantitative Introduction to Biology</td>
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<tr>
<td>BIOL 304</td>
<td>Fitting Models to Data: Maximum Likelihood Methods and Model Selection</td>
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<td>Design and Analysis of Biological Experiments</td>
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<td>BIOL 327</td>
<td>Functional Genomics</td>
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<td>BIOL 352</td>
<td>Ecology and Evolution of Infectious Diseases</td>
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<td>BIOL 373</td>
<td>Introduction to Neurobiology (effective Fall 2014; previously an organismal elective)</td>
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<tr>
<td>BIOL 397</td>
<td>Molecular Phylogenetics</td>
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One additional laboratory course (excluding BIOL 388, BIOL 388S, and BIOL 390) 2-4

<table>
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<tr>
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<td>Vertebrate Biology (lab or organismal elective, not both)</td>
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<td>Dynamics of Biological Systems: A Quantitative Introduction to Biology</td>
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<tr>
<td>BIOL 301</td>
<td>Biotechnology Laboratory: Genes and Genetic Engineering</td>
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<td>BIOL 305</td>
<td>Herpetology</td>
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<td>BIOL 309</td>
<td>Biology Field Studies</td>
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<tr>
<td>BIOL 310</td>
<td>Field Studies in Evolutionary Ecology</td>
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<td>BIOL 315</td>
<td>Quantitative Biology Laboratory</td>
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<tr>
<td>BIOL 318</td>
<td>Introductory Entomology (lab or organismal elective, not both)</td>
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<td>BIOL 321</td>
<td>Design and Analysis of Biological Experiments</td>
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<td>BIOL 338</td>
<td>Ichthyology (lab or organismal elective, not both)</td>
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<td>BIOL 339</td>
<td>Aquatic Biology Laboratory</td>
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<tr>
<td>BIOL 344</td>
<td>Laboratory for Microbiology</td>
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Total Units 86-96
At least 11 hours of the selected electives and additional laboratory courses must be at the 300 level or higher.

**BS Biology, Suggested Sequence of Courses**

### First Year

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<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tr>
<td></td>
<td>Genes, Evolution and Ecology (BIOL 214)</td>
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<td>Genes, Evolution and Ecology Lab (BIOL 214L)</td>
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<td>Cells and Proteins (BIOL 215)</td>
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<td>Principles of Chemistry I (CHEM 105)</td>
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<td>SAGES First Seminar</td>
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### Second Year

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<td>Development and Physiology (BIOL 216)</td>
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<td>Introductory Organic Chemistry Laboratory I (CHEM 233)</td>
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<td>SAGES University Seminar</td>
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<td>GER Course</td>
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<td>Genetics (BIOL 326)</td>
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<td>Introductory Organic Chemistry II (CHEM 224) or Organic Chemistry II (CHEM 324)</td>
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<td>Elementary Computer Programming (ENGR 131)</td>
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### Third Year

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<tr>
<td></td>
<td>BIOL Elective</td>
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<tr>
<td></td>
<td>BIOL Elective</td>
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<tr>
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<td>or BIOL Laboratory</td>
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<td></td>
<td>Advanced Mathematics or Statistics Course</td>
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<td></td>
<td>Introductory Physics I (PHYS 115) or General Physics I - Mechanics (PHYS 121)</td>
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<td>GER Course</td>
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<td>BIOL Elective</td>
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### Fourth Year

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<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td></td>
<td>Undergraduate Research - SAGES Capstone (BIOL 388S) (SAGES Capstone)</td>
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<td>BIOL Elective</td>
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<td></td>
<td>BIOL Laboratory</td>
<td>2-4</td>
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<tr>
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<td>or Quantitative BIOL Laboratory (if needed)</td>
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<td>Introductory Physical Chemistry I (CHEM 301)</td>
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<td>Open Elective</td>
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<td>Advanced Undergraduate Research (BIOL 390)</td>
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<td>BIOL Elective</td>
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<td>BIOL Elective (if needed)</td>
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### Total Units in Sequence:

121-126

**Bachelor of Science in Systems Biology**

Systems biology is a rapidly emerging area of research activity at the interface of mathematics, computer science, and the biological sciences. Many modern areas of biology research (e.g., biochemical, neural, behavioral, and ecosystem networks) require the mastery of advanced quantitative and computational skills. The Systems Biology BS degree program is intended to provide the quantitative and multidisciplinary understanding that is necessary for work in these areas. This skill set is different from that produced by traditional undergraduate programs in biology. Consequently, the Systems Biology BS program includes a specialized four-course core curriculum (different from the three-course core used in the Biology BA and BS programs), as well as foundation courses from computer science and advanced mathematics.

Undergraduate research is strongly recommended as BIOL 388S Undergraduate Research - SAGES Capstone and BIOL 390 Advanced Undergraduate Research, but is not formally required.

Note: A revised Systems Biology BS curriculum was introduced in Fall 2016. Legacy students who took BIOL 250 and/or BIOL 251 should contact Katie Bingman (kathryn.bingman@case.edu), undergraduate coordinator for the Department of Biology, to insure that these courses are credited appropriately.

**Systems Biology core courses**

<p>| Units | BIOL 214 | Genes, Evolution and Ecology | 3 |
|-------|---------------------------------|---|
|       | BIOL 215 | Cells and Proteins | 3 |
|       | BIOL 216 | Development and Physiology | 3 |
|       | BIOL 300 | Dynamics of Biological Systems: A Quantitative Introduction to Biology | 3 |</p>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 306</td>
<td>Mathematical Analysis of Biological Models</td>
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<td><strong>Approved subspecialty sequence</strong> (choose one of the following four sequences)</td>
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<tr>
<td></td>
<td><strong>Neuroscience (any two courses)</strong></td>
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<tr>
<td>BIOL 322</td>
<td>Sensory Biology</td>
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</tr>
<tr>
<td>BIOL 373</td>
<td>Introduction to Neurobiology</td>
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<tr>
<td>BIOL 374</td>
<td>Neurobiology of Behavior</td>
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<td>BIOL 376</td>
<td>Neurobiology Laboratory</td>
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<tr>
<td>BIOL 378</td>
<td>Computational Neuroscience</td>
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<td>or MATH 378</td>
<td>Computational Neuroscience</td>
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<tr>
<td>NEUR 402</td>
<td>Principles of Neural Science</td>
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<tr>
<td></td>
<td><strong>Bioinformatics and genetics (any two courses)</strong></td>
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<tr>
<td>BIOL 301</td>
<td>Biotechnology Laboratory: Genes and Genetic Engineering</td>
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<tr>
<td>BIOL 308</td>
<td>Molecular Biology</td>
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<tr>
<td>BIOL 311A &amp; BIOL 311B &amp; BIOL 311C</td>
<td>Survey of Bioinformatics: Technologies in Bioinformatics and Survey of Bioinformatics: Data Integration in Bioinformatics and Survey of Bioinformatics: Translational Bioinformatics</td>
<td>6-8</td>
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<tr>
<td>or SYBB 311A &amp; SYBB 311B &amp; SYBB 311C</td>
<td>Survey of Bioinformatics: Technologies in Bioinformatics and Survey of Bioinformatics: Data Integration in Bioinformatics and Survey of Bioinformatics: Translational Bioinformatics</td>
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<tr>
<td>BIOL 326</td>
<td>Genetics</td>
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<td>BIOL 327</td>
<td>Functional Genomics</td>
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<td>BIOL 328</td>
<td>Plant Genomics and Proteomics</td>
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<td>BIOL 397</td>
<td>Molecular Phylogenetics</td>
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<td>EECS 458</td>
<td>Introduction to Bioinformatics</td>
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<tr>
<td>EECS 459</td>
<td>Bioinformatics for Systems Biology</td>
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<td><strong>Ecology and evolutionary biology (any two courses)</strong></td>
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<td>BIOL 307</td>
<td>Evolutionary Biology of the Invertebrates</td>
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<td>BIOL 310</td>
<td>Field Studies in Evolutionary Ecology</td>
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<td>BIOL 345</td>
<td>Mammal Diversity and Evolution</td>
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<td>BIOL 353</td>
<td>Ecophysiology of Global Change</td>
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<td>Animal Behavior</td>
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<td>BIOL 364</td>
<td>Research Methods in Evolutionary Biology</td>
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<td>BIOL 365</td>
<td>Evo-Devo: Evolution of Body Plans and Pathologies</td>
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<td>BIOL 472</td>
<td>Foundations of Advanced Evolution</td>
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<td>Introduction to Stem Cell Biology</td>
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<td>Cell Biology</td>
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<td>The Human Microbiome</td>
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<td>Structural Biology</td>
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<td>Laboratory for Microbiology</td>
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<td>Principles of Developmental Biology</td>
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<td>BIOL 363</td>
<td>Experimental Developmental Biology</td>
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<td>BIOL 365</td>
<td>Evo-Devo: Evolution of Body Plans and Pathologies</td>
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<td>Undergraduate Research - SAGES Capstone and Advanced Undergraduate Research</td>
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<td>Physics and Frontiers I - Mechanics</td>
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</tr>
<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Computer science core courses</strong></td>
<td></td>
</tr>
<tr>
<td>EECS 132</td>
<td>Introduction to Programming in Java</td>
<td>3</td>
</tr>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 302</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 304</td>
<td>Discrete Mathematics</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Systems Electives (any two courses)</strong></td>
<td>6-7</td>
</tr>
</tbody>
</table>
### Systems Biology - Suggested Sequence of Courses

Computer science-oriented students are recommended to take EECS 132 before the PHYS 121 / PHYS 122 sequence. Other students may take physics first. The schedule below shows both options.

#### First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genes, Evolution and Ecology (BIOL 214)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry I (CHEM 105)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Principles of Chemistry Laboratory (CHEM 113)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>SAGES First Seminar</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PHED Physical Education</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cells and Proteins (BIOL 215)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

#### Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development and Physiology (BIOL 216)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121)</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223) or Calculus III (MATH 227)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GER Course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Dynamics of Biological Systems: A Quantitative Introduction to Biology (BIOL 300)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122) or General Physics I - Mechanics (PHYS 121)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224) or Differential Equations (MATH 228)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GER Course</td>
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<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15-16</td>
<td>16</td>
</tr>
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</table>

#### Third Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Analysis of Biological Models (BIOL 306)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Discrete Mathematics (EECS 302) or Discrete Mathematics (MATH 304)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIOL Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Introduction to Programming in Java (EECS 132) or General Physics II - Electricity and Magnetism (PHYS 122)</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>GER Course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Basic Statistics for Engineering and Science (STAT 312) or Basic Statistics for Engineering and Science Using R Programming (STAT 312R)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Introduction to Data Structures (EECS 233)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>BIOL Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>SAGES Departmental Seminar</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GER Course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15-16</td>
<td>16</td>
</tr>
</tbody>
</table>

#### Fourth Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGES Capstone</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Undergraduate Research - SAGES Capstone (BIOL 388S) is recommended.
Subspecialty Elective & 3  
Systems Elective & 3  
Open Electives & 6  
**BIOL Elective** & 3  
  **Advanced Undergraduate Research (BIOL 390)** (recommended) &  
Subspecialty Elective & 3  
Systems Elective & 3  
**BIOL Elective (if needed)** or & 3  
Open Elective &  
Open Elective & 3  
Year Total: & 15  
**Total Units in Sequence:** & 124-126  

**Concentrations in Areas of the Biological Sciences**

Students are encouraged to utilize their elective courses in the biology major to take advantage of concentrations in various specialized areas. These concentrations have been developed between the biology department, the basic science departments of the School of Medicine, and other departments. Currently, concentrations have been developed in the following areas: biotechnology and genetic engineering; computational biology; developmental biology; genetics; cell and molecular biology; neurobiology and animal behavior; population biology, ecology and environmental science. Note: these concentrations are informal; they are not declared, and will not appear on the student’s diploma or transcript.

**Advising**

Biology faculty advisors are assigned to students at the time of major or minor declaration. All biology majors are required to meet with their departmental advisors at least once each semester to discuss their academic program, receive clearance for electronic course registration, and obtain approval for any drops, adds, or withdrawals. Please contact Katie Bingman (kathryn.bingman@case.edu), undergraduate coordinator for the Department of Biology, for information about major or minor declaration.

**Departmental Honors**

To receive a bachelor’s degree “with Honors in Biology” (formally noted on the transcript), the student must meet the following criteria:

1. Maintain a 3.4 overall grade point average, with a 3.6 in BIOL courses
2. Carry out two semesters of independent research (taken as BIOL courses) at Case Western Reserve University
3. Write a senior honors thesis with the approval of the faculty supervisor
4. Submit the thesis for review by an *ad hoc* honors committee
5. Successfully defend the thesis at an oral examination

Additional information and application forms are available from the biology department office.

**Minor**

The biology minor requires 16 credits of biology courses. Students must take any two of the three biology core lectures with their associated laboratories, plus electives. Legacy students who have taken BIOL 250 and/or BIOL 251 should contact Katie Bingman (kathryn.bingman@case.edu), undergraduate coordinator for the Department of Biology, to insure that these courses are credited appropriately.

Any two of the following biology core lectures (and associated labs) & 8  
  **BIOL 214 & 214L** & Genes, Evolution and Ecology and Genes, Evolution and Ecology Lab  
  **BIOL 215 & 215L** & Cells and Proteins and Cells and Proteins Laboratory  
  **BIOL 216 & 216L** & Development and Physiology and Development and Physiology Lab  
**BIOL electives (excluding 100-level courses, BIOL 240, and BIOL 390)** & 8  
**Total Units** & 16  

**Graduate Programs**

**Master of Science**

The Department of Biology offers both thesis and non-thesis Master of Science degree programs. Both programs require a minimum of 30 semester hours of courses at the 300 level or higher. A minimum of 18 semester hours of formal course work is required for the thesis degree, and a minimum of 24 semester hours of formal course work for the non-thesis degree. The remaining credits may be research credits (BIOL 601 Research and BIOL 651 Thesis M.S.). The Entrepreneurial Biotechnology (EB) is a two-year Plan A professional MS degree in Biology. The EB program includes four (4) required courses, an internship and electives to make up the 30 semester hours. The thesis is based on a real entrepreneurial project with an existing company or your own startup (the internship).

**Plan A (Thesis)**

The Plan A Master of Science degree in biology is a thesis graduate degree program. The purpose of the program is to provide advanced exposure to biology for interested professionals, to provide additional training for those wishing to resume or change careers, or to provide additional preparation in biology for students interested in pursuing professional studies in the health sciences. Students are required to write and defend a Master of Science thesis.

**Program of Study**

All candidates must complete a total of 30 credit hours in course work at the 300 level or higher within 5 years of matriculation into the graduate program. At least 18 of these credit hours must be at the 400 level or above. Further, at least 15 credit hours must be in courses offered by the biology department. The remaining course work may include courses offered by any department within the University, subject to an advisor’s approval and School of Graduate Studies regulations. Candidates are limited to 3 credit hours of BIOL 601 Research, but may take up to 9 credit hours of BIOL 651 Thesis M.S. According to rules of the School of Graduate Studies, once a candidate registers for BIOL 651, the registration must continue for a minimum of 1 credit per semester until completion of the degree program. Students who are uncertain about completing requirements for a Plan A master’s degree should consult the regulations for the Plan B Master’s degree. These two master’s degrees have different regulations concerning use of BIOL 601.
A candidate may wish to use BIOL 599 Advanced Independent Study for Graduate Students; the letter grade assigned will reflect the evaluation by the entire Advisory Committee.

**Plan A (Thesis) Entrepreneurial Biotechnology**

The Entrepreneurial Biotechnology (EB) students study state-of-the-art biotechnology, practical business, and technology innovation while working on a real-world entrepreneurial project with an existing company or their own startup. The EB helps to connect students with mentors, advisors, partners, funding sources and job opportunities. EB prepares students to work in diverse research or technology-centered environments. The Entrepreneurial Biotechnology Program (EB) requires students to write a thesis in order to graduate with a Master of Science in Biology, Entrepreneurship Track. The thesis must be based on a project of significant time investment on the part of the student and must be grounded in the real world (i.e., not simply an academic exercise). Thus, each student is required to work as an intern, employee, or entrepreneur typically with a start-up, existing company, early-stage investment firm, or affiliate of a research organization. The duration must be at least one year, with one semester reserved for full-time work outside of the classroom (usually the fourth and final semester). Under this requirement, international students will be permitted no more than one semester of full-time curricular practical training (CPT).

**Plan B (Non-thesis)**

The Plan B Master of Science degree in biology is a non-thesis graduate degree program. The purpose of the program is to provide advanced exposure to biology for interested professionals, to provide additional training for those wishing to resume or change careers, or to provide additional preparation in biology for students interested in pursuing professional studies in the health sciences. Students are not required to write a Master of Science thesis, but the program does require passing a comprehensive oral examination.

**Program of Study**

All candidates must complete a total of 30 credit hours in course work at the 300 level or higher. At least 18 of these credit hours must be at the 400 levels or above. Further, at least 15 credit hours must be in courses offered by the Biology Department. At least one course must be taken in each of the following areas of biology: cell and molecular biology (including chemical biology), organismal biology, and population biology. The remaining course work may include courses offered by any department within the University, subject to the advisor’s approval and School of Graduate Studies regulations. Candidates are limited to a total of 6 credit hours of independent study (BIOL 599 Advanced Independent Study for Graduate Students or BIOL 601 Research). Both of these courses require completion of a Course Proposal Form (available in the Biology Departmental Office) and approval by the advisor. In the case of enrollment in BIOL 599, the letter grade assigned will reflect the evaluation by a three person committee recruited by the student and advisor.

**Doctor of Philosophy**

The degree of Doctor of Philosophy is awarded in recognition of in-depth knowledge in a major field and comprehensive understanding of related subjects together with a demonstration of ability to perform independent investigation and to communicate the results of such investigation in an acceptable dissertation.

Students entering with a bachelor’s degree will satisfactorily complete a minimum of 36 credit hours (which may include independent study/research taken as BIOL 601 Research), tutorials, and seminars. For students entering with an approved master’s degree, completion of at least 18 semester hours of course work is required. A minimum of 18 semester hours of dissertation research (BIOL 701 Dissertation Ph.D.) is required for all doctoral students.

Teaching experience is an integral part of the graduate training. Students are involved in supervised laboratory teaching in selected undergraduate courses taking into account both the specialized areas of interest of the student and his or her broader professional development. The normal teaching requirement consists of four semesters.

**Department Faculty**

Mark A. Willis, PhD  
(University of California, Riverside)  
*Professor; Chair*  
Neurobiology and behavior; sensorimotor control of insect flight; animal behavior

Karen C. Abbott, PhD  
(University of Chicago)  
*Associate Professor*  
Ecology; theoretical biology

Radhika Atit, PhD  
(University of Cincinnati)  
*Professor*  
Developmental biology and genetics; origin and patterning of skin

Sarah C. Bagby, PhD  
(Massachusetts Institute of Technology)  
*Assistant Professor*  
Microbial and viral evolution and community dynamics; geobiology; microbial physiology; bioinformatics and ecoinformatics

Michael F. Benard, PhD  
(University of California, Davis)  
*Associate Professor*  
Ecology; evolutionary biology

Rebecca Benard, PhD  
(University of California, Davis)  
*Senior Instructor*  
Plant population ecology; physiology

Susan M. Burden-Gulley, PhD  
(Case Western Reserve University)  
*Instructor*  
Neuroscience; axonal growth; neural development; brain cancer

Jean H. Burns, PhD  
(Florida State University)  
*Associate Professor*  
Plant ecology; community assembly; invasibility; the role of phylogeny in assembly; the role of demographic processes in biological invasions

Arnold I. Caplan, PhD  
(Johns Hopkins University)  
*Professor; Director, Skeletal Research Center*  
Developmental biology and biochemistry; molecular and cellular aspects of muscle, cartilage, and bone development
Leena Chakravarty, PhD  
(Ohio State University)  
Instructor  
Microbial molecular genetics

Hillel J. Chiel, PhD  
(Massachusetts Institute of Technology)  
Professor  
Neurobiology and animal behavior; cellular dynamics of neuronal computation

Christopher A. Cullis, PhD  
(University of East Anglia, United Kingdom)  
George B. Mayer Chair in Urban and Environmental Studies; Assistant Professor  
Plant molecular biology and genetics; modifications of the information content of plant cells

Sarah E. Diamond, PhD  
(University of North Carolina, Chapel Hill)  
Assistant Professor  
Evolutionary ecology; global change biology; invertebrate immunology; multivariate statistics

Richard F. Drushel, PhD  
(Case Western Reserve University)  
Senior Instructor; Executive Officer  
Vertebrate anatomy and physiology; kinematic modeling and neural control; autonomous robotics

Jessica L. Fox, PhD  
(University of Washington)  
Assistant Professor  
Neurobiology of behavior

Stephen E. Haynesworth, PhD  
(Case Western Reserve University)  
Associate Professor; Associate Dean, College of Arts and Sciences  
Developmental and aging biology

Valerie Haywood, PhD  
(University of California, Davis)  
Senior Instructor  
Plant developmental biology; molecular biology

Emmitt R. Jolly, PhD  
(University of California, San Francisco)  
Associate Professor  
Molecular biology and genetics; developmental biology; parasitology; schistosomiasis

Barbara A. Kuermerle, PhD  
(Case Western Reserve University)  
Senior Instructor  
Molecular biology and genetics; developmental neuroscience

Ryan A. Martin, PhD  
(University of North Carolina, Chapel Hill)  
Assistant Professor  
Evolutionary ecology; behavioral ecology; ecology's role in evolutionary diversification; causes and consequences of phenotypic plasticity

Claudia M. Mizutani, PhD  
(Federal University of Rio de Janeiro, Brazil)  
Associate Professor  
Developmental biology and genetics; embryonic body-axis formation

Ronald G. Oldfield, PhD  
(University of Michigan)  
Senior Instructor  
Evolutionary ecology of cichlid fishes; ichthyology

Roy E. Ritzmann, PhD  
(University of Virginia)  
Professor  
Neurobiology of behavior; insect locomotion and brain studies

Charles E. Rozek, PhD  
(Wayne State University)  
Associate Professor; Vice Provost; Dean of Graduate Studies  
Molecular genetics; developmental biology

Robin Snyder, PhD  
(University of California, Santa Barbara)  
Associate Professor  
Theoretical ecology

Research Faculty

Jean F. Welter, MD, PhD  
(Leopold Franzens Universität, Austria; Case Western Reserve University)  
Research Associate Professor  
Tissue engineering and cell-based therapies; bioreactor design; mechanobiology; bone transplantation; imaging; fluorescence spectroscopy; drug delivery

Secondary Faculty

Darin Croft, PhD  
(University of Chicago)  
Associate Professor, Department of Anatomy, School of Medicine  
Vertebrate paleontology and fieldwork; mammals, especially those of South America; paleoecology and ancient ecosystems

Brian M. McDermott, PhD  
(Columbia University)  
Assistant Professor, Department of Otolaryngology, University Hospitals of Cleveland  
Neurobiology; hearing and deafness; zebrafish; mechanotransduction; synapse development

Scott W. Simpson, PhD  
(Kent State University)  
Associate Professor, Department of Anatomy, School of Medicine  
Hominid paleontology and fieldwork; hominid dentition; locomotor capacities of early Homo erectus

Peter Thomas, PhD  
(University of Chicago)  
Associate Professor, Department of Mathematics, Applied Mathematics, and Statistics  
Synchronization and reliability of neural activity; gradient sensing, signal transduction and information theory; pattern formation in the visual cortex; malaria informatics
Adjunct Faculty

James Bader, MS
(Case Western Reserve University)
Adjunct Lecturer; Executive Director, Gelfand STEM Center
STEM education; aquatic biology

David J. Burke, PhD
(Rutgers University)
Adjunct Assistant Professor; Scientist, Holden Arboretum
Rhizosphere ecology; plant-microbe interactions; molecular microbial ecology; plant ecology

Pam Dennis, PhD, DVM
(Ohio State University; College of Veterinary Medicine, North Carolina State University)
Adjunct Assistant Professor; Clinical Assistant Professor, Cleveland Metroparks Zoo
Veterinary wildlife epidemiology in zoo and free-ranging animal populations

Nancy DiIulio, PhD
(Pennsylvania State University College of Medicine)
Adjunct Instructor; Senior Associate Dean, Undergraduate Studies
Cell biology; biochemistry

Nicole L. Gunter, PhD
(University of Queensland, Australia)
Adjunct Assistant Professor; Collections Manager, Department of Invertebrate Zoology, Cleveland Museum of Natural History
Phylogenetics and systematics of dung beetles

Johannes Haile-Selassie, PhD
(University of California, Berkeley)
Adjunct Professor; Curator/Head, Department of Physical Anthropology, Cleveland Museum of Natural History
Hominin paleobiology; Plio-Miocene mammalian evolution; paleobiogeography; paleoecology

Christopher Kuhar, PhD
(Georgia Institute of Technology)
Adjunct Assistant Professor; Executive Director, Cleveland Metroparks Zoo
Conservation and education program evaluation; experimental psychology; animal behavior

Ana B. Locci, PhD
(Case Western Reserve University)
Adjunct Assistant Professor; Director, University Farm
Aquatic ecology and population biology

Kristen E. Lukas, PhD
(Georgia Institute of Technology)
Adjunct Assistant Professor; Curator, Conservation and Science, Cleveland Metroparks Zoo
Applied animal behavior; behavior and health; visitor attitudes and behavior

Audrey Lynn, PhD
(Case Western Reserve University)
Adjunct Instructor
Human genetics; chromosome behavior during meiosis; mitochondrial disorders

Juliana S. Medeiros, PhD
(University of New Mexico)
Adjunct Assistant Professor; Scientist, Holden Arboretum
Plant physiological ecology; evolutionary ecology; acclimation and adaptation to the abiotic environment; carbon and water relations

Denise F. Su, PhD
(New York University)
Adjunct Assistant Professor; Curator/Head, Department of Paleobotany and Paleocology, Cleveland Museum of Natural History
Paleocology; human evolution; functional morphology

Gavin J. Svenson, PhD
(Brigham Young University)
Adjunct Assistant Professor; Curator/Head, Department of Invertebrate Zoology, Cleveland Museum of Natural History
Phylogenetics and systematics

Lecturers

Deborah L. Harris, MS
(Wright State University)
Full-time Lecturer
Aquatic biofouling; mycology

Dianne M. Kube, PhD
(University of North Dakota School of Medicine)
Full-time Lecturer
Cell biology, cystic fibrosis

Emeritus Faculty

Robert P. Davis, PhD
(Cornell University)
Associate Professor of Biology Emeritus; Dean of Collegiate Affairs Emeritus
Developmental biology

Morris Burke, PhD
(University of New South Wales, Australia)
Professor Emeritus
Muscle physiology; protein chemistry

Joseph F. Koonce, PhD
(University of Wisconsin, Madison)
Professor Emeritus
Aquatic ecology; systems ecology

Martin J. Rosenberg, PhD
(State University of New York, Stony Brook)
Senior Instructor Emeritus
Herpetology; vertebrate biology; human anatomy and physiology

Norman B. Rushforth, PhD
(Cornell University)
Professor Emeritus
Epidemiology, animal behavior; population biology
Assignments will be in the form of a scientific journal submission. Prerequisites include genetics, biotechnology; population genetics and evolution, ecology. Basics of cell structure (with a focus on malaria research); molecular biology; and cloning. Main topics included in the Physiology portion consist of: homeostasis, the function of neurons and nervous systems; the major organ systems and processes involved in circulation, excretion, osmoregulation, gas exchange, feeding, digestion, temperature regulation, endocrine function and the immunologic response. There are two instructional modes for this course: lecture mode and hybrid mode. In the lecture mode students attend class for their instruction. In the hybrid mode students watch online lectures from the course instructor and attend one discussion section with the course instructor each week. The online content prepares students for the discussion. Which mode is offered varies depending on the term. Students are made aware of what mode is offered at the time of registration. The total student effort required is identical for both instructional modes. Either instructional mode fulfills the BIOL 216 requirement for the BA and BS in Biology. Prerequisites: (Undergraduate Student and BIOL 214) or Requisites Not Met permission.

BIOL 215. Cells and Proteins. 3 Units.
Second in a series of three courses required of the Biology major. Topics include: protein structure-function, enzymes kinetics; cell structure; cellular energetics, respiration and photosynthesis. In addition, membrane structure and transport will be covered. Laboratory and discussion sessions offered in alternate weeks. This course is not available for students who have taken BIOL 215 as a 4-credit course. Prerequisites: BIOL 214L and Prerequisite or Corequisite: BIOL 215.

BIOL 216. Development and Physiology. 3 Units.
This is the final class in the series of three courses required of the Biology major. As with the two previous courses, BIOL 214 and 215, this course is designed to provide an overview of fundamental biological processes. It will examine the complexity of interactions controlling reproduction, development and physiological function in animals. The Developmental Biology section will review topics such as gametogenesis, fertilization, cleavage, gastrulation, the genetic control of development, stem cells and cloning. Main topics included in the Physiology portion consist of: homeostasis, the function of neurons and nervous systems; the major organ systems and processes involved in circulation, excretion, osmoregulation, gas exchange, feeding, digestion, temperature regulation, endocrine function and the immunologic response. There are two instructional modes for this course: lecture mode and hybrid mode. In the lecture mode students attend class for their instruction. In the hybrid mode students watch online lectures from the course instructor and attend one discussion section with the course instructor each week. The online content prepares students for the discussion. Which mode is offered varies depending on the term. Students are made aware of what mode is offered at the time of registration. The total student effort required is identical for both instructional modes. Either instructional mode fulfills the BIOL 216 requirement for the BA and BS in Biology. Prerequisite: (Undergraduate Student and BIOL 214) or Requisites Not Met permission.

BIOL 216L. Development and Physiology Lab. 1 Unit.
Third in a series of three laboratory courses required of the Biology major. Students will conduct laboratory experiments designed to provide hands-on, empirical laboratory experience in order to better understand the complex interactions governing the basic physiology and development of organisms. Laboratories and discussion sessions offered in alternate weeks. Prerequisites: BIOL 214L. Prerequisite or Corequisite: BIOL 216.

BIOL 223. Vertebrate Biology. 3 Units.
A survey of vertebrates from jawless fishes to mammals. Functional morphology, physiology, behavior and ecology as they relate to the groups' relationships with their environment. Evolution of organ systems. Two lectures and one laboratory per week. The laboratory will involve a study of the detailed anatomy of the shark and cat used as representative vertebrates. Students are expected to spend at least three hours of unscheduled laboratory each week. This course fulfills a laboratory requirement for the biology major.
BIOL 225. Evolution. 3 Units.
Multidisciplinary study of the course and processes of organic evolution provides a broad understanding of the evolution of structural and functional diversity, the relationships among organisms and their environments, and the phylogenetic relationships among major groups of organisms. Topics include the genetic basis of micro- and macro-evolutionary change, the concept of adaptation, natural selection, population dynamics, theories of species formation, principles of phylogenetic inference, biogeography, evolutionary rates, evolutionary convergence, homology, Darwinian medicine, and conceptual and philosophic issues in evolutionary theory. Offered as ANTH 225, BIOL 225, EEPS 225, HSTY 225, and PHIL 225.

BIOL 240. Personalized Medicine. 3 Units.
The emphasis of clinical practice is slowly shifting from one-disease and one-treatment-fits-all to more personalized care based on molecular markers of disease risk, disease subtype, drug effectiveness, and adverse drug reactions. This course, designed for non-biology majors, will introduce how the developments in gene sequencing, genetic markers, and stem cells can be applied for predictive testing and personalized therapies. Core concepts to be covered include the principles of genetics including the inheritance of traits determined by single genes and by multiple genes, the assignment of risk to particular genetic constitutions, and the nature and use of stem cells. The emergence of private companies as resources for the performance of the tests, and how the general public will be able to interpret their own data (with or without the access to genetic counselors), will also be covered. The course will include hands-on laboratory experiences of DNA manipulation and detection using the polymerase chain reaction and gel electrophoresis. The ethical, legal, and social issues associated with personal genetic testing will also be covered. This course does not count towards any Biology degree, nor towards the Biology minor.

BIOL 300. Dynamics of Biological Systems: A Quantitative Introduction to Biology. 3 Units.
This course will introduce students to dynamic biological phenomena, from the molecular to the population level, and models of these dynamical phenomena. It will describe a biological system, discuss how to model its dynamics, and experimentally evaluate the resulting models. Topics will include molecular dynamics of biological molecules, kinetics of cell metabolism and the cell cycle, biophysics of excitability, scaling laws for biological systems, biomechanics, and population dynamics. Mathematical tools for the analysis of dynamic biological processes will also be presented. Students will manipulate and analyze simulations of biological processes, and learn to formulate and analyze their own models. This course satisfies a laboratory requirement for the biology major. Offered as BIOL 300 and EBME 300.

BIOL 301. Biotechnology Laboratory: Genes and Genetic Engineering. 3 Units.
Laboratory training in recombinant DNA techniques. Basic microbiology, growth, and manipulation of bacteriophage, bacteria and yeast. Students isolate and characterize DNA, construct recombinant DNA molecules, and reintroduce them into eukaryotic cells (yeast, plant, animal) to assess their viability and function. Two laboratories per week. Offered as BIOL 301 and BIOL 401. Prereq: BIOL 215 or BIOL 250.

BIOL 302. Human Learning and the Brain. 3 Units.
This course focuses on the question, “How does the human brain learn?” Through assigned readings, extensive class discussions, and a major paper, each student will explore personal perspectives on learning. Specific topics include, but are not limited to: the brain’s cycle of learning; neocortex structure and function; emotion and limbic brain; synapse dynamics and changes in learning; images in cognition; symbolic brain (language, mathematics, music); memory formation; and creative thought and brain mechanisms. The major paper will be added to each student’s SAGES writing portfolio. In addition, near the end of the semester, each student will make an oral presentation on a chosen topic. Offered as BIOL 302 and COGS 322. Counts as SAGES Departmental Seminar.

BIOL 303. From Blackbox to Toolbox: How Molecular Biology Moves Forward. 3 Units.
The pioneers of modern biology knew very little about the internal workings of the cell, and they had access only to a very limited set of very low-resolution tools. Yet clean experimental design and careful analysis let them ask and answer fundamental biological questions and enabled the development of better tools to use the next time around. In just seven decades, biologists have built a toolbox that offers astonishing precision and power, but the logic of biological experimentation hasn’t changed. In this course, we will study that underlying logic, and what it lets us do. We will read key papers spanning the development of modern biology, from the most basic working-out of the Central Dogma to recent advances. We will pay particular attention to how well the authors used the tools available, and how successfully they accounted for their shortcomings—if indeed they did. The emphasis of the course will be on classroom discussion. In lieu of exams, students will (1) write brief responses to weekly in-class prompts for understanding, (2) write in-depth proposals for a molecular biology research project, and (3) present their proposals orally to the class. These assignments are designed to check that students are keeping up with weekly discussions and synthesizing what they have learned into a deeper understanding of how we develop questions and construct arguments in biological research. This course is offered as a SAGES departmental seminar and fulfills the Cell and Molecular breadth requirement of the B.A. and B.S. in Biology. Counts as SAGES Departmental Seminar. Prereq: BIOL 215.

BIOL 304. Fitting Models to Data: Maximum Likelihood Methods and Model Selection. 3 Units.
This course will introduce students to maximum likelihood methods for fitting models to data and to ways of deciding which model is best supported by the data (model selection). Along the way, students will learn some basic tenets of probability and develop competency in R, a commonly used statistical package. Examples will be drawn from ecology, epidemiology, and potentially other areas of biology. The second half of the course is devoted to in-class projects, and students are encouraged to bring their own data. Offered as BIOL 304 and BIOL 404. Prereq: MATH 121 and MATH 122 OR MATH 125 and MATH 126.
BIOL 305. Herpetology. 4 Units.
Amphibians and reptiles exhibit tremendous diversity in development, physiology, anatomy, behavior and ecology. As a result, amphibians and reptiles have served as model organisms for research in many different fields of biology. This course will cover many aspects of amphibian and reptile biology, including anatomy, evolution, geographical distribution, physiological adaptations to their environment, reproductive strategies, moisture, temperature, and food-relations, sensory mechanisms, predator-prey relationships, communication (vocal, chemical, behavioral), population biology, and the effects of venomous snake bite. Laboratory sessions will be devoted to learning species identification and evolutionary relationships, discussion of the ecology of Ohio’s amphibians and reptiles, survey techniques for determining population size and structure, and observations of the behavior of live reptiles and amphibians. Laboratory sessions may include trips to Squire Valleveue Farm, Cleveland Museum of Natural History, and Cleveland Metroparks Zoo. Prereq: BIOL 214 or BIOL 251.

BIOL 306. Mathematical Analysis of Biological Models. 3 Units.
This course focuses on the mathematical methods used to analyze biological models, with examples drawn largely from ecology but also from epidemiology, developmental biology, and other areas. Mathematical topics include equilibrium and stability in discrete and continuous time, some aspects of transient dynamics, and reaction-diffusion equations (steady state, diffusive instabilities, and traveling waves). Biological topics include several “classic” models, such as the Lotka-Volterra model, the Ricker model, and Michaelis-Menten/type II/saturating responses. The emphasis is on approximations that lead to analytic solutions, not numerical analysis. An important aspect of this course is translating between verbal and mathematical descriptions: the goal is not just to solve mathematical problems but to extract biological meaning from the answers we find. Offered as BIOL 306 and MATH 376. Prereq: BIOL 300 or MATH 224 or MATH 228.

BIOL 307. Evolutionary Biology of the Invertebrates. 3 Units.
Important events in the evolution of invertebrate life, as well as structure, function, and phylogeny of major invertebrate groups.

BIOL 308. Molecular Biology. 4 Units.
An examination of the flow of genetic information from DNA to RNA to protein. Topics include: nucleic acid structure; mechanisms and control of DNA, RNA, and protein biosynthesis; recombinant DNA; and mRNA processing and modification. Where possible, eukaryotic and prokaryotic systems are compared. Special topics include yeast as a model organism, molecular biology of cancer, and molecular biology of the cell cycle. Current literature is discussed briefly as an introduction to techniques of genetic engineering. Recommended preparation: BIOL 307. Offered as BIOL 308, BIOL 308, BIOL 408, and BIOL 408. Prereq: BIOL 215 or BIOL 307.

BIOL 309. Biology Field Studies. 3 Units.
Intensive investigation of living organisms in a natural environment. Location of the field site may vary with each course offering, and may be either domestic or international. Topics covered include logistics, biodiversity, and current ecological, environmental, and social issues surrounding the specific ecosystem being studied. Time at the field site will be spent listening to resident lecturers, receiving guided tours, observing and identifying wild organisms in their natural habitat, and conducting a research project. The undergraduate version requires students to plan and conduct a group research project and present results independently. The graduate version requires students to plan, conduct, and present an independent research project. Instructor consent required to register. This course will fulfill a laboratory requirement of the B.A. in Biology. This course will fulfill an additional laboratory requirement of the B.S. in Biology. Course may be repeated for credit up to two times if traveling to a new destination. Offered as BIOL 309 and BIOL 409. Prereq: BIOL 216.

BIOL 310. Field Studies in Evolutionary Ecology. 3 Units.
The field of Evolutionary Ecology examines how the interactions between organisms and their environments evolve. In this field-based course, students will conduct a variety of experimental and observational field studies aimed at addressing key concepts in Evolutionary Ecology. Students will gain experience in study design and data collection in natural populations, data analysis, and the writing and presentation of scientific results. This course satisfies a laboratory requirement of a B.A. in Biology. This course satisfies an additional laboratory requirement of a B.S. in Biology. Prereq: BIOL 214.

BIOL 311A. Survey of Bioinformatics: Technologies in Bioinformatics. 1 Unit.
SYBB 311A/411A is a 5-week course that introduces students to the high-throughput technologies used to collect data for bioinformatics research in the fields of genomics, proteomics, and metabolomics. In particular, we will focus on mass spectrometer-based proteomics, DNA and RNA sequencing, genotyping, protein microarrays, and mass spectrometry-based metabolomics. This is a lecture-based course that relies heavily on out-of-class readings. Graduate students will be expected to write a report and give an oral presentation at the end of the course. SYBB 311A/411A is part of the SYBB survey series which is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming skills. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311A, BIOL 311A and SYBB 411A. Prereq: BIOL 214 and BIOL 215 or BIOL 250. Coreq: BIOL 311B, BIOL 311C, and BIOL 311D.
BIOL 311B. Survey of Bioinformatics: Data Integration in Bioinformatics. 1 Unit.
SYBB 311B/411B is a five week course that surveys the conceptual models and tools used to analyze and interpret data collected by high-throughput technologies, providing an entry points for students new to the field of bioinformatics. The knowledge structures that we will cover include: biomedical ontologies, signaling pathways, and interaction networks. We will also cover tools for genome exploration and analysis. The SYBB survey series is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311B, BIOL 311B, and SYBB 411B. Prereq: (BIOL 214 and BIOL 215) or BIOL 250. Coreq: BIOL 311A, BIOL 311C, and BIOL 311D.

BIOL 311C. Survey of Bioinformatics: Translational Bioinformatics. 1 Unit.
SYBB 311C/411C is a longitudinal course that introduces students to the latest applications of bioinformatics, with a focus on translational research. Topics include: `omic drug discovery, pharmacogenomics, microbiome analysis, and genomic medicine. The focus of this course is on illustrating how bioinformatic technologies can be paired with data integration tools for various applications in medicine. The course is organized as a weekly journal club, with instructors leading the discussion of recent literature in the field of bioinformatics. Students will be expected to complete readings beforehand; students will also work in teams to write weekly reports reviewing journal articles in the field. The SYBB survey series is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311B, BIOL 311B, and SYBB 411B. Prereq: (BIOL 214 and BIOL 215) or BIOL 250. Coreq: BIOL 311A, BIOL 311C, and BIOL 311D.

BIOL 314. Taming the Tree of Life: Phylogenetic Comparative Methods- from Concept to Practical Application. 3 Units.
"Nothing in biology makes sense except in the light of evolution" – Dobzhansky Biologists have long been fascinated by the diversity of life. Why are there so many species? Why are some of them similar and others divergent? How has evolution shaped ecological interactions, such as disease-host dynamics? The "tree of life" describes phylogenetic hypotheses for evolutionary history among species, and modern phylogenetic comparative methods allow us to incorporate the tree of life into statistical analyses. This course will introduce phylogenetic comparative methods, why they are needed to answer many biological questions, how they are conducted, and how they can be used to evaluate hypotheses. These methods can be used for any group of organisms, from humans and their diseases, to plants, animals, or fungi. These methods also can be used to address a broad suite of questions in biology, including biomedical, ecological, evolutionary, developmental, and neuromechanical questions. For example, issues of public health can be more deeply addressed using these tools. Students may bring their own data sets, or may use existing data sets, and will develop an independent research project using these tools. Undergraduates will present a poster at a public poster fair, as part of the requirements for the SAGES capstone. No prior experience with the R statistics language is necessary for this course. BIOL314 fulfills the requirements for an undergraduate capstone in biology. Offered as BIOL 314 and BIOL 414. Prereq: (Undergraduate student with at least Junior standing and BIOL 214) or Requisite Not Met permission.

BIOL 315. Quantitative Biology Laboratory. 3 Units.
This course will apply a range of quantitative techniques to explore structure-function relations in biological systems. Using a case study approach, students will explore causes of impairments of normal function, will assemble diverse sets of information into a database format for the analysis of causes of impairment, will analyze the data with appropriate statistical and other quantitative tools, and be able to communicate their results to both technical and non-technical audiences. The course has one lecture and one lab per week. Students will be required to maintain a journal of course activities and demonstrate mastery of quantitative tools and statistical techniques. Graduate students will have a final project that applies these techniques to a problem of their choice. Offered as BIOL 315 and BIOL 415. Prereq: BIOL 214 or BIOL 251.

BIOL 316. Fundamental Immunology. 4 Units.
Introductory immunology providing an overview of the immune system, including activation, effector mechanisms, and regulation. Topics include antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity, innate versus adaptive immunity, cytokines, and basic molecular biology and signal transduction in B and T lymphocytes, and immunopathology. Three weekly lectures emphasize experimental findings leading to the concepts of modern immunology. An additional recitation hour is required to integrate the core material with experimental data and known immune mediated diseases. Five mandatory 90 minute group problem sets per semester will be administered outside of lecture and recitation meeting times. Graduate students will be graded separately from undergraduates, and 22 percent of the grade will be based on a critical analysis of a recently published, landmark scientific article. Offered as BIOL 316, BIOL 416, CLBY 416, PATH 316 and PATH 416. Prereq: BIOL 215 and 215L.
BIOL 318. Introductory Entomology. 4 Units.
The goal of this course is to discover that, for the most part, insects are not aliens from another planet. Class meetings will alternate; with some structured as lectures, while others are laboratory exercises. Sometimes we will meet at the Cleveland Museum of Natural History, or in the field to collect and observe insects. The 50 minute discussion meeting once a week will serve to address questions from both lectures and lab exercises. The students will be required to make a small but comprehensive insect collection. Early in the semester we will focus on collecting the insects, and later, when insects are gone for the winter, we will work to identify the specimens collected earlier. Students will be graded based on exams, class participation and their insect collections. Offered as BIOL 318 and BIOL 418. Prereq: BIOL 214 and BIOL 215 and BIOL 216 or BIOL 250 and BIOL 251

BIOL 319. Applied Probability and Stochastic Processes for Biology. 3 Units.
Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419. Prereq: MATH 224 or MATH 223 and BIOL 300 or BIOL 306 and MATH 201 or MATH 307 or consent of instructor.

BIOL 321. Design and Analysis of Biological Experiments. 3 Units.
In this laboratory course, students will learn how to use a computer programming language (MATLAB) to design, execute, and analyze biological experiments. The course will begin with basic programming and continue to data output and acquisition, image analysis, and statistics. Students who are interested in carrying out research projects in any lab setting are encouraged to take this course and use the skills acquired to better organize and analyze their experiments. No prior programming knowledge is assumed. This course satisfies a laboratory requirement of the B.A. in biology. This course satisfies a laboratory requirement of the B.S. in biology. Students will complete a final project on a topic of their choice; graduate students will be required to give an oral presentation of this project. Offered as BIOL 321 and BIOL 421. Counts for CAS Quantitative Reasoning Requirement. Prereq: BIOL 216 or BIOL 251.

BIOL 322. Sensory Biology. 3 Units.
The task of a sensory system is to collect, process, store, and transmit information about the environment. How do sensory systems convert information from the environment into neural information in an animal’s brain? This course will explore the ecology, physiology, and behavior of the senses across the animal kingdom. We will cover introductory neurobiology and principles of sensory system organization before delving more deeply into vision, olfaction, audition, mechanosensation, and multi-modal sensory integration. For each sensory modality, we will consider how the sensory system operates and how its operation affects the animal’s behavior and ecology. We will also explore the evolution of sensory systems and their specialization for specific behavioral tasks. Students will finish the course with a research project on a topic of their choice; graduate students will present this project to the class. Offered as BIOL 322 and BIOL 422. Prereq: BIOL 216 or BIOL 251.

BIOL 324. Introduction to Stem Cell Biology. 3 Units.
This discussion-based course will introduce students to the exciting field of stem cell research. Students will first analyze basic concepts of stem cell biology, including stem cell niche, cell quiescence, asymmetric cell division, cell proliferation and differentiation, and signaling pathways involved in these processes. This first part of the course will focus on invertebrate genetic models for the study of stem cells. In the second part of the course, students will search for primary research papers on vertebrate and human stem cells, and application of stem cell research in regenerative medicine and cancer. Finally, students will have the opportunity to discuss about ethical controversies in the field. Students will rotate in weekly presentations, and will write two papers during the seminar. Students will improve skills on searching and reading primary research papers, gain presentation skills, and further their knowledge in related subjects in the fields of cell biology, genetics and developmental biology. This course may be used as a cell/molecular subject area elective for the B.A. and B.S. Biology degrees. Offered as BIOL 324 and BIOL 424. Prereq: BIOL 325 or BIOL 326 or BIOL 362.

BIOL 325. Cell Biology. 3 Units.
This course will emphasize an understanding of the structure and function of eukaryotic cells from a molecular viewpoint. We will explore cell activities by answering the questions: What are the critical components of specific cellular processes and how are they regulated? An important part of this course will be appreciation of the experimental evidence that supports our current understanding of cell function. To achieve this aim, we will highlight a variety of experimental techniques currently used in research, and students will read papers from the primary literature to supplement the text. Topics will include cell structure, protein structure and function, internal organization of the eukaryotic cell, membrane structure and function, protein sorting, organelle biogenesis, and cytoskeleton structure and function. The course will also cover the life cycles of cells, their interactions with each other and their environment, intracellular signaling and cell death mechanisms. After establishing a detailed understanding of cell biology, we will explore how normal cellular processes go awry, leading to diseases such as cancer. This course fulfills the Cell and Molecular breadth requirement of the B.A. and B.S. in Biology. Prereq: BIOL 215.

BIOL 326. Genetics. 3 Units.
Transmission genetics, nature of mutation, microbial genetics, somatic cell genetics, recombinant DNA techniques and their application to genetics, human genome mapping, plant breeding, transgenic plants and animals, uniparental inheritance, evolution, and quantitative genetics. Offered as BIOL 326 and BIOL 426. Prereq: (Undergraduate student and BIOL 214) or Requisites Not Met permission.
BIOL 327. Functional Genomics. 3 Units.
In this course, students will learn how to access and use genomics data to address questions in cell biology, development and evolution. The genome of Drosophila melanogaster will serve as a basis for exploring genome structure and learning how to use a variety of available software to identify similar genes in different species, predict protein sequence and functional domains, design primers for PCR, analyze cis-regulatory sequences, access microarray and RNAseq databases, among others. Classes will be in the format of short lectures, short oral presentations made by students and hands-on experimentation using computers. Discussions will be centered in primary research papers that used these tools to address specific biological questions. A final project will consist of a research project formulated by a group of 2-3 students to test a hypothesis formulated by the students using the bioinformatics tools learned in the course. Graduate students will be required to make additional presentations of research papers. They also will have additional questions in exams and a distinct page requirement on written assignments. This course satisfies a laboratory requirement of the B.A. in Biology. This course satisfies a laboratory or quantitative laboratory requirement of the B.S. in Biology. Offered as BIOL 327 and BIOL 427. Prereq: BIOL 214L and BIOL 326.

BIOL 328. Plant Genomics and Proteomics. 3 Units.
The development of molecular tools has impacted agriculture as much as human health. The application of new techniques to improve food crops, including the development of genetically modified crops, has also become controversial. This course covers the nature of the plant genome and the role of sequenced-based methods in the identification of the genes. The application of the whole suite of modern molecular tools to understand plant growth and development, with specific examples related agronomically important responses to biotic and abiotic stresses, is included. The impact of the enormous amounts of data generated by these methods and their storage and analysis (bioinformatics) is also considered. Finally, the impact on both the developed and developing world of the generation and release of genetically modified food crops will be covered. Recommended preparation: BIOL 326. Offered as BIOL 328 and BIOL 428.

BIOL 333. The Human Microbiome. 3 Units.
This departmental seminar is designed to reveal how the abundant community of human-associated microorganisms influence human development, physiology, immunity and nutrition. Using a survey of current literature, this discussion-based course will emphasize an understanding of the complexity and dynamics of human/microbiome interactions and the influence of environment, genetics and individual life histories on the microbiome and human health. Grades will be based on participation, written assignments, exams, oral presentation and a final paper. Prerequisites are completion of BIOL 214 and BIOL 216. This class is offered as a SAGES Departmental Seminar and fulfills an Organismal breadth requirement of the BA and BS in Biology. Currently the class is not open to graduate students. Counts as SAGES Departmental Seminar. Prereq: BIOL 214 and BIOL 216.

BIOL 334. Structural Biology. 3 Units.
Introduces basic chemical properties of proteins and discusses the physical forces that determine protein structure. Topics include: the elucidation of protein structure by NMR and by X-ray crystallographic methods; the acquisition of protein structures from data bases; and simple modeling experiments based on protein structures. Offered as BIOC 334, BIOL 334, BIOC 434, and BIOL 434.

BIOL 336. Aquatic Biology. 3 Units.
Physical, chemical, and biological dynamics of lake ecosystems. Factors governing the distribution, abundance, and diversity of freshwater organisms. Offered as BIOL 336 and BIOL 436. Prereq: BIOL 214 or BIOL 251.

BIOL 338. Ichthyology. 4 Units.
Biology of fishes. Students will develop fundamental understanding of the evolutionary history and systematics of fishes to provide a context within which they can address aspects of biology including anatomy, physiology (e.g., in species that change sex; osmoregulation in freshwater vs. saltwater), and behavior (e.g., visual, auditory, chemical, electric communication; social structures), ecology, and evolution (e.g., speciation). We will explore the biodiversity of fishes around the world, with emphasis on Ohio species, by examining preserved specimens, observing captive living specimens, and observing, capturing, and identifying wild fishes in their natural habitats. Practical applications will be emphasized, such as aquaculture, fisheries management, and biomedical research. Course will conclude with an analysis of the current global fisheries crisis that has resulted from human activities. There will be many field trips and networking with the Cleveland Metroparks Zoo, the Cleveland Museum of Natural History, and local, state, and federal government agencies. Some classes meet at the Cleveland Museum of Natural History. This course satisfies a laboratory requirement of the B.A. and B.S. in biology. The graduate version of the course requires a research project and term paper. Offered as BIOL 338 and BIOL 438. Prereq: BIOL 216 or BIOL 251.

BIOL 339. Aquatic Biology Laboratory. 2 Units.
The physical, chemical, and biological limnology of freshwater ecosystems will be investigated. Emphasis will be on identification of the organisms inhabiting these systems and their ecological interactions with each other. This course will combine both field and laboratory analysis to characterize and compare the major components of these ponds. Students will have the opportunity to design and conduct individual projects. Prereq or Coreq: BIOL 336.

BIOL 340. Human Physiology. 3 Units.
This course will provide functional correlates to the students' previous knowledge of human anatomy. Building upon the basic principles covered in BIOL 214 and BIOL 346, the physiology of organs and organ systems of humans, including the musculoskeletal, nervous, cardiovascular, lymphatic, immune, respiratory, digestive, excretory, reproductive, and endocrine systems, will be studied at an advanced level. The contribution of each system to homeostasis will be emphasized. Prereq: (Undergraduate Student and BIOL 346 and BIOL 215 and BIOL 216) or Requisites Not Met permission.

BIOL 342. Parasitology. 3 Units.
This course will introduce students to classical and current parasitology. Students will discuss basic principles of parasitology, parasite life cycles, host-parasite interaction, therapeutic and control programs, epidemiology, and ecological and societal considerations. The course will explore diverse classes of parasitic organisms with emphasis on protozoan and helminthic diseases and the parasites' molecular biology. Group discussion and selected reading will facilitate further integrative learning and appreciation for parasite biology. This course counts as an elective in the cell/molecular biology subject area for the Biology B.A. and B.S. degrees. Offered as BIOL 342 and BIOL 442. Prereq: BIOL 214, BIOL 215, BIOL 216 and BIOL 326.
**BIOL 343. Microbiology. 3 Units.**
The physiology, genetics, biochemistry, and diversity of microorganisms. The subject will be approached both as a basic biological science that studies the molecular and biochemical processes of cells and viruses, and as an applied science that examines the influence of microorganisms in human disease as well as in workings of ecosystems, plant symbioses, and industrial processes. The course is divided into four major areas: bacteria, viruses, medical microbiology, and environmental and applied microbiology. Offered as BIOL 343 and BIOL 443. Prereq: BIOL 215 or BIOL 250.

**BIOL 344. Laboratory for Microbiology. 3 Units.**
Practical microbiology, with an emphasis on bacteria as encountered in a variety of situations. Sterile techniques, principles of identification, staining and microscopy, growth and nutritional characteristics, genetics, enumeration methods, epidemiology, immunological techniques (including ELISA and T cell identification), antibiotics and antibiotic resistance, chemical diagnostic tests, sampling the human environment, and commercial applications. One three hour lab plus one lecture per week. Prereq or Coreq: BIOL 343.

**BIOL 345. Mammal Diversity and Evolution. 4 Units.**
This course focuses on the anatomical and taxonomic diversity of mammals in an evolutionary context. The emphasis is living (extant) mammals, but extinct mammals are also discussed. By the end of the course, students will be able to: (1) describe the key anatomical and physiological features of mammals; (2) name all orders and most families of living mammals; (3) identify a mammal skull to order and family; (4) understand how to create and interpret a phylogenetic tree; (5) appreciate major historical patterns in mammal diversity and biogeography as revealed by the fossil record. Two student-led seminars and one lab each week. Most labs will take place at the Cleveland Museum of Natural History. One weekend field trip to Cleveland Metroparks Zoo. This course satisfies a laboratory requirement for the biology major. Offered as ANAT 445, BIOL 345, and BIOL 445. Prereq: BIOL 214.

**BIOL 346. Human Anatomy. 3 Units.**
Gross anatomy of the human body. Two lectures and one laboratory demonstration per week. Prereq: (Undergraduate Student and BIOL 216) or Requisites Not Met permission.

**BIOL 351. Principles of Ecology. 3 Units.**
This lecture course explores spatial and temporal relationships involving organisms and the environment at individual, population, and community levels. An underlying theme of the course will be neo-Darwinian evolution through natural selection with an emphasis on organismal adaptations to abiotic and biotic environments. Studies and models will illustrate ecological principles, and there will be some emphasis on the applicability of these principles to ecosystem conservation. Students taking the graduate level course will prepare a grant proposal in which hypotheses will be based on some aspect of ecological theory. Offered as BIOL 351 and BIOL 451. Prereq: BIOL 214 or BIOL 251.

**BIOL 351L. Principles of Ecology Laboratory. 2 Units.**
Students in this laboratory course will conduct a variety of ecological investigations that are designed to examine relationships involving organisms and the environment at individual, population, and community levels. Descriptive and hypothesis-driven investigations will take place at Case Western Reserve University's Squire Valley Farm, in both field and greenhouse settings. The course is designed to expose as well as test a variety of ecological paradigms. Students taking the graduate level course will prepare a grant proposal in which hypotheses will be based on a select number of lab investigations. This course satisfies a laboratory requirement for biology majors. Recommended preparation for BIOL 451L: prior or concurrent enrollment in BIOL 451. Offered as BIOL 351L and BIOL 451L. Prereq or Coreq: BIOL 351.

**BIOL 352. Ecology and Evolution of Infectious Diseases. 3 Units.**
This course explores the effects of infectious diseases on populations of hosts, including humans and other animals. We will use computer models to study how infectious diseases enter and spread through populations, and how factors like physiological and behavioral differences among host individuals, host and pathogen evolution, and the environment affect this spread. Our emphasis will be on understanding and applying quantitative models for studying disease spread and informing policy in public health and conservation. To that end, computer labs are the central component of the course. This course satisfies a laboratory requirement of the B.A. in biology. The course satisfies a laboratory or quantitative laboratory requirement of the B.S. in biology. Offered as BIOL 352 and BIOL 452. Prereq: (Undergraduate Student and BIOL 214 and (MATH 121 or MATH 125) and (MATH 122 or MATH 126)) or Requisites Not Met permission.

**BIOL 353. Ecophysiology of Global Change. 3 Units.**
Global change is an emerging threat to human health and economic stability. Rapid changes in climate, land use, and prevalence of non-native species generate novel conditions outside the range of typical conditions under which organisms evolved. Already we are witnessing the global redistribution of plants and animals, changes in the timing of critical life cycle events, and in some cases local extinction of populations. This course explores the impacts of global change on biological systems at levels from individuals to ecosystems; among animals, plants and microbes; across ecological to evolutionary timescales; and from local to global spatial scales. Throughout, physiology is emphasized as a core driver of biological responses to global change. Traditional lectures will be accompanied by discussions of primary literature articles. The laboratory component will involve the development of an independent project at the University Farm, and dissemination of results through traditional (e.g. written paper) and new (e.g. podcast) media. This class will fulfill a laboratory requirement of the B.A. in Biology. This class will fulfill an additional laboratory requirement of the B.S. in Biology. Offered as BIOL 353 and BIOL 453. Prereq: BIOL 214. Prereq or Coreq: BIOL 216.
BIOL 357. Backyard Behavior Capstone. 3 Units.
Interesting animal behavior is all around us. We need not go into a laboratory to observe it, but laboratory tools can help to understand the behaviors that we encounter every day. We interact with animals in our homes, in forests and wilderness areas and even in our own backyards. As pet dogs or cats interact with wild squirrels and birds, they provide insights regarding predation, neuromechanics, and mating behaviors, just to list a few concepts. This course takes advantage of the rich behavior that exists around us to provide a capstone experience for students who have an interest in animal behavior. The course will be open to 10 senior Biology majors who have emphasized the animal behavior and neurobiology courses offered by the Biology department. Each student will have taken at least one advanced course in Animal Behavior, Neurobiology, or Neuroethology. Entry into the course will be by permit, and permits will be issued only after an interview in which each student demonstrates to the instructor a deep interest in animal behavior and underlying neural control systems. Through classroom discussion, viewing of behaviorally-based video shows, and field trips, each student will choose one behavior to investigate in detail over the course of the semester. In order to move beyond casual observation to in-depth analysis, video cameras will be available to the students, as well as computer based motion analysis systems. The class will meet as a group twice weekly. During this formal classroom period, students will discuss behaviors in general and , as the course progresses, the specific topics that each student is investigating. They will present journal articles that are relevant to their topics, a prospectus on their intended projects, and ultimately describe their projects outside of class time and will present a poster at a public poster fair. Counts as SAGES Senior Capstone. Prereq: BIOL 305 or BIOL 318 or BIOL 358 or BIOL 373 or BIOL 374.

BIOL 358. Animal Behavior. 4 Units.
Ultimately the success or failure (i.e., life or death) of any individual animal is determined by its behavior. The ability to locate and capture food, avoid being food, acquiring and defending territory, and successfully passing your genes to the next generation, are all dependent on complex interactions between an animal’s design, environment and behavior. This course will be an integrative approach emphasizing experimental studies of animal behavior. You will be introduced to state-of-the-art approaches to the study of animal behavior, including neural and hormonal mechanisms, genetic and developmental mechanisms and ecological and evolutionary approaches. We will learn to critique examples of current scientific papers, and learn how to conduct observations and experiments with real animals. We will feature guest appearances by the Curator of Research from the Cleveland MetroParks Zoo and visits to working animal behavior research labs here at CWRU. Group discussions and writing will be emphasized. This course satisfies a laboratory requirement for biology majors. Offered as BIOL 358 and BIOL 458. Prereq: BIOL 214 and BIOL 215 and BIOL 216 or BIOL 250 and BIOL 251.

BIOL 362. Principles of Developmental Biology. 3 Units.
The descriptive and experimental aspects of animal development. Gametogenesis, fertilization, cleavage, morphogenesis, induction, differentiation, organogenesis, growth, and regeneration. Students taking the graduate-level course will prepare an NIH-format research proposal as the required term paper. Offered as BIOL 362, BIOL 462 and ANAT 462. Prereq: BIOL 216 or BIOL 251 or EBME 201 and EBME 202.

BIOL 363. Experimental Developmental Biology. 3 Units.
This laboratory course will teach concepts and techniques in developmental biology. Emphasis will be on the mechanisms that pattern the embryo during development and how these mechanisms are explored using molecular, cellular, and genetic approaches. A term research paper is required. Students taking the graduate level course will prepare a grant proposal. One laboratory and one lecture per week. Offered as BIOL 363 and BIOL 463. Prereq: BIOL 362.

BIOL 364. Research Methods in Evolutionary Biology. 3 Units.
The process of evolution explains not only how the present diversity of life on earth has formed, but also provides insights into current pressing issues today, including the spread of antibiotic resistance, the causes of geographic variation in genetic diseases, and explanations for modern patterns of extinction risk. Students in Research Methods in Evolutionary Biology will be introduced to several of the major research approaches of evolutionary biology, including methods of measuring natural selection on the phenotypic and genotypic levels, quantifying the rate of evolution, reconstructing evolutionary relationships, and assessing the factors that affect rates of speciation and extinction. The course will consist of a combination of interactive lectures, in-class problem solving and data analysis, and the discussion of peer-reviewed scientific papers. Grades are based on participation in class, discussions and written summaries of published papers, in-class presentations, and two writing assignments. Offered as BIOL 364 and BIOL 464. Counts as SAGES Departmental Seminar. Prereq: BIOL 214 or BIOL 251.

BIOL 365. Evo-Devo: Evolution of Body Plans and Pathologies. 3 Units.
This discussion-based course offers a detailed introduction to Evolutionary Developmental Biology. The field seeks to explain evolutionary events through the mechanisms of Developmental Biology and Medical Genetics. The course is structured into different modules. First we will look at the developmental genetic mechanisms that can cause variation and medical pathologies. Then we focus on how alterations of these mechanisms can generate novel structural changes. We will then examine a few areas of active debate, where Evo-Devo is attempting to solve major problems in evolutionary biology and congenital birth defects. We will conclude with two writing assignments. Students will be required to present, read, and discuss primary literature in each module. This course is offered as a SAGES Departmental Seminar and fulfills a Cell and Molecular breadth requirement of the BA and BS in Biology. Offered as BIOL 365 and BIOL 465. Counts as SAGES Departmental Seminar. Prereq: Undergraduate Student and (BIOL 225 or BIOL 326 or BIOL 362) or Requisites Not Met permission.

BIOL 368. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467. Prereq: BIOL 225 or equivalent.
BIOL 369. Evolutionary Biology Capstone. 3 Units.
This course focuses on a special topic of interest in evolutionary biology that will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. Students will participate in discussions and lead class seminars on evolutionary topics and in collaboration with an advisor or advisors, select a topic for a research paper or project. Each student will write a major research report or complete a major project and will make a public presentation of her/his findings. Offered as ANTH 368, BIOL 369, and PHIL 368. Counts as SAGES Senior Capstone.

BIOL 373. Introduction to Neurobiology. 3 Units.
How nervous systems control behavior. Biophysical, biochemical and molecular properties of nerve cells, their organization into circuitry, and their function within networks. Emphasis on quantitative methods for modeling neurons and networks, and on critical analysis of the contemporary technical literature in the neurosciences. Term paper required for graduate students. This course satisfies a lab requirement for the B.A. in Biology, and a Quantitative Laboratory requirements for the B.S. in Biology. Offered as BIOL 373, BIOL 473, and NEUR 473.

BIOL 374. Neurobiology of Behavior. 3 Units.
In this course, students will examine how neurobiologists interested in animal behavior study the linkage between neural circuitry and complex behavior. Various vertebrate and invertebrate systems will be considered. Several exercises will be used in this endeavor. Although some lectures will provide background and context on specific neural systems, the emphasis of the course will be on classroom discussion of specific journal articles. In addition, students will each complete a project in which they will observe some animal behavior and generate both behavioral and neurobiological hypotheses related to it. In lieu of examinations, students will complete three written assignments, including a theoretical grant proposal, a one-page Specific Aims paper related to the project, and a final project paper. These assignments are designed to give each student experience in writing biologically-relevant documents. Classroom discussions will help students understand the content and format of each type document. They will also present their projects orally to the entire class. Offered as BIOL 374, BIOL 474 and NEUR 474. Counts as SAGES Departmental Seminar.

BIOL 376. Neurobiology Laboratory. 3 Units.
Introduction to the basic laboratory techniques of neurobiology. Intracellular and extracellular recording techniques, forms of synaptic plasticity, patch clamping, immunohistochemistry and confocal microscopy. During the latter weeks of the course students will be given the opportunity to conduct an independent project. One laboratory and one discussion session per week. Recommended preparation for BIOL 476 and NEUR 476. BIOL 216. Offered as BIOL 376, BIOL 476 and NEUR 476. Prereq: BIOL 216 or BIOL 251.

BIOL 377. Biorobotics Team Research. 3 Units.
Many exciting research opportunities cross disciplinary lines. To participate in such projects, researchers must operate in multi-disciplinary teams. The Biorobotics Team Research course offers a unique capstone opportunity for undergraduate students to utilize skills they developed during their undergraduate experience while acquiring new teaming skills. A group of eight students form a research team under the direction of two faculty leaders. Team members are chosen from appropriate majors through interviews with the faculty. They will research a biological mechanism or principle and develop a robotic device that captures the actions of that mechanism. Although each student will cooperate on the team, they each have a specific role, and must develop a final paper that describes the research generated on their aspect of the project. Students meet for one class period per week and two 2-hour lab periods. Initially students brainstorm ideas and identify the project to be pursued. They then acquire biological data and generate robotic designs. Both are further developed during team meetings and reports. Final oral reports and a demonstration of the robotic device occur in week 15. Offered as BIOL 377, EMAE 377, BIOL 467, and EMAE 477. Counts as SAGES Senior Capstone.

BIOL 378. Computational Neuroscience. 3 Units.
Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECS 478, MATH 478 and NEUR 478.

BIOL 379. Transformative Animal Models in Modern Biology. 3 Units.
Animal models are extremely important in the study of biology and in modern medicine. They allow us to determine fundamental biological mechanisms and cellular and molecular causes of disease. There is logic to how each animal model has found its place in the menagerie of accepted animal models. Certain animal models allow us to test particular hypotheses that may not be possible to address in other animals. Moreover, some animal models are more relevant than others to studying a particular human disease. This seminar-based course will focus on animal models that either are effective at modeling human disease, approach relevant neurobiological questions, or play a role in translational medicine. The course will focus on mammalian and non-mammalian animal models that are important to biomedical research, including the primate, mouse, zebrafish, and roundworm. Comparisons between popular animal models will be made. This course fulfills the Organismal breadth requirement of the BA and BS in Biology. Offered as BIOL 379 and BIOL 479. Counts as SAGES Departmental Seminar. Prereq: BIOL 326 or BIOL 373.
BIOL 382. Drugs, Brain, and Behavior. 3 Units.
This course is concerned with the mechanisms underlying neurochemical signaling and the impact of drugs on those mechanisms. The first half of the course emphasizes the fundamental mechanisms underlying intra- and extracellular communication of neurons and the basic principles of how drugs interact with the nervous system. The second half of the course emphasizes understanding the neural substrates of disorders of the nervous system, and the mechanisms underlying the therapeutic effects of drugs at the cellular and behavioral levels. This course will consist of lectures designed to give the student necessary background for understanding these basic principles and class discussion. The class discussion will include viewing video examples of behavioral effects of disorders of the nervous system, and analysis of research papers. The goal of the class discussions is to enhance the critical thinking skills of the student and expose the student to contemporary research techniques. Offered as BIOL 382, BIOL 482, and NEUR 482. Prereq: BIOL 215 and BIOL 216 or BIOL 250 and BIOL 251.

BIOL 384. Reading and Writing Like an Ecologist. 3 Units.
Students usually learn from textbooks, but scientists communicate with each other through journal articles. The purpose of this class is to help you learn to read and write like an ecologist. We will spend our time reading and discussing journal articles about three or four issues in ecology, including papers from both empirical and theoretical perspectives. In addition to the science, we'll talk about strategies for how to keep reading when you encounter something you don't understand and what makes a paper well or poorly written. At the end of each section, you will synthesize your ideas into a review article. Your initial paper will be submitted to me as hypothetical journal editor. I will send your paper out for review to two fellow classmates, and I'll send their comments back to you along with brief comments of my own. As all scientists know, it is virtually unheard of for a journal to accept a paper for publication without revisions. After this peer review, you will revise your papers and resubmit them to me. Your grade will be based on your participation in class discussions, your papers (both drafts) and your work as a reviewer for other students. Counts as SAGES Departmental Seminar. Prereq: BIOL 214 or BIOL 251.

BIOL 385. Seminar on Biological Processes in Learning and Cognition. 3 Units.
Students will read and discuss research papers on a range of topics relevant to the biological processes that lead to cognition and learning in humans. Sample topics are: cellular and molecular mechanisms of memory; visual sensory detection of images, movement, and color; role of slow neurotransmitters in synaptic plasticity; cortical distribution of cognitive functions such as working memory, decision making, and image analysis; functions of emotion-structures and their role in cognition; brain structures and mechanisms involved in language creation; others. Some papers will be assigned and others will be selected by students. Discussions will focus on the methods used, the experimental results, and the interpretations of significance. Students will work in groups on a semester project to be presented near the end of the semester. Counts as SAGES Senior Capstone. Prereq: BIOL 302.

BIOL 388. Undergraduate Research. 1 - 3 Units.
Guided laboratory research under the sponsorship of a biology faculty member. May be carried out within the biology department or in associated departments. Appropriate forms must be secured in the biology department office. A written report must be approved by the biology sponsor and submitted to the chairman of the biology department before credit is granted. Only 3 credit-hours may count towards the biology majors or minor. Offered as BIOL 388 and SYBB 388.

BIOL 388S. Undergraduate Research - SAGES Capstone. 3 Units.
Guided laboratory research under the sponsorship of a biology faculty member. May be carried out within the biology department or in associated departments. May be taken only one semester during the student's academic career. Appropriate forms must be secured in the biology department office. A written report must be approved by the biology sponsor and submitted to the chairman of the biology department before credit is granted. A public presentation is required. Offered as BIOL 388S and SYBB 388S. Counts as SAGES Senior Capstone.

BIOL 389. Selected Topics. 1 - 3 Units.
Individual library research projects completed under the guidance of a biology sponsor. May be carried out within the biology department or in associated departments. Appropriate forms must be secured in the biology department office. A written report must be approved by the biology sponsor and submitted to the chairman of the biology department before credit is granted. Only 3 credit-hours may count towards the biology majors or minor.

BIOL 389S. Selected Topics in Biology-SAGES Capstone. 3 Units.
Individual library research projects under the guidance of a biology sponsor. A major paper must be submitted and approved before credit is awarded. A public presentation is required. Counts as SAGES Senior Capstone.

BIOL 390. Advanced Undergraduate Research. 1 - 3 Units.
Offered on a credit only basis. Students may carry out research in biology or related departments, but a biology sponsor is required. Does not count toward the 30 hours required for a major in biology, but may be counted toward the total number of hours required for graduation. A written report must be submitted to the chairman's office and approved before credit is granted. Prereq: BIOL 388 or BIOL 388S

BIOL 395. Research Discussions. 1 Unit.
This is a seminar course which provides a forum within which students performing undergraduate research, or who have done so previously, can present and discuss their projects. Discussions will cover all aspects of the students' research projects: background material, experimental design and methods, results and their analysis and conclusions. At the beginning of the semester, each student will briefly outline his or her project and distribute a few key papers to provide background reading for all participants. After this introductory phase, each student will make a presentation of his/her own research. Graded as pass/fail, based upon attendance and participation. Prereq: BIOL 388. Prereq or coreq: BIOL 390.

BIOL 396. Undergraduate Research in Evolutionary Biology. 3 Units.
Students propose and conduct guided research on an aspect of evolutionary biology. The research will be sponsored and supervised by a member of the CASE faculty or other qualified professional. A written report must be submitted to the Evolutionary Biology Steering Committee before credit is granted. Offered as ANTH 396, BIOL 396, EEPS 396, and PHIL 396.
BIOL 397. Molecular Phylogenetics. 4 Units.
This course is designed to teach the theory and practice of molecular based phylogenetics with attention to evolutionary analysis through lecture, readings, discussion, and a quantitative laboratory section. A comprehensive overview of the history of systematics and morphology based phylogenetics will help familiarize students with the theory, methods, and character analysis frameworks used in current genetic based approaches. A laboratory section of the course will provide working knowledge in designing and carrying out an original phylogenetics project beginning with data procurement to writing a research manuscript. Through readings and discussions of research articles as well as presented content, the relevant course material will be utilized in practice by students analyzing their project data sets. The semester-long research project will take students through the process of building a data set, aligning sequences, reconstructing phylogenies, conducting evolutionary analyses, and interpreting and writing results as a scientific manuscript. In addition, students will orally present their research proposal as well as the final research project. Undergraduate students will work in teams of two on the research project component of the course and independently throughout the other course components (discussions). Graduate students will work independently and have an extra assignment. This course satisfies a laboratory requirement of the B.A. in Biology. This course satisfies a laboratory or quantitative laboratory requirement of the B.S. in Biology. Offered as: BIOL 397 and BIOL 497. Prereq: BIOL 214 and (BIOL 225 or BIOL 364).

BIOL 398. Modern Human Biological Variation. 3 Units.
The objectives of this course are to provide students with an introduction to human biological variation and to understand the variation within an evolutionary framework through lecture, readings, discussion, and labs. We will examine the patterns of morphological and genetic variation in modern human populations and discuss the evolutionary explanations for the observed patterns. In order to do this, we will first build a solid foundation in the scientific method, population genetics, and evolutionary theory before exploring the adaptive significance of the observed variation. A major component of the class will be the discussion of the social and health implications of these patterns of biological variation, particularly in the construction and application of the concept of race and its use in medicine. There are three units to the course. Unit 1 focuses on the fundamentals to understanding biological variation, we will cover basic population genetics, evolution, and the human fossil record. Unit 2 concentrates on surveying modern human biological variation, examining both morphological and genetic traits, and why these variations exist. Unit 3 examines how race is constructed using population-based biological differences, its validity, and the implications for health and medicine. This course fulfills the Population and Ecology breadth requirement of the B.A. and B.S. in Biology. Offered as BIOL 398 and BIOL 498. Prereq: BIOL 214.

BIOL 401. Biotechnology Laboratory: Genes and Genetic Engineering. 3 Units.
Laboratory training in recombinant DNA techniques. Basic microbiology, growth, and manipulation of bacteriophage, bacteria and yeast. Students isolate and characterize DNA, construct recombinant DNA molecules, and reintroduce them into eukaryotic cells (yeast, plant, animal) to assess their viability and function. Two laboratories per week. Offered as BIOL 301 and BIOL 401.

BIOL 402. Principles of Neural Science. 3 Units.
Lecture/discussion course covering concepts in cell and molecular neuroscience, principles of systems neuroscience as demonstrated in the somatosensory system, and fundamentals of the development of the nervous system. This course will prepare students for upper level Neuroscience courses and is also suitable for students in other programs who desire an understanding of neurosciences. Recommended preparation: CBIO 453. Offered as BIOL 402 and NEUR 402.

BIOL 404. Fitting Models to Data: Maximum Likelihood Methods and Model Selection. 3 Units.
This course will introduce students to maximum likelihood methods for fitting models to data and to ways of deciding which model is best supported by the data (model selection). Along the way, students will learn some basic tenets of probability and develop competency in R, a commonly used statistical package. Examples will be drawn from ecology, epidemiology, and potentially other areas of biology. The second half of the course is devoted to in-class projects, and students are encouraged to bring their own data. Offered as BIOL 304 and BIOL 404. Prereq: MATH 121 and MATH 122 OR MATH 125 and MATH 126 or consent of instructor.

BIOL 407. Introduction to Biochemistry: From Molecules To Medical Science. 4 Units.
Overview of the macromolecules and small molecules key to all living systems. Topics include: protein structure and function; enzyme mechanisms, kinetics and regulation; membrane structure and function; bioenergetics; hormone action; intermediary metabolism, including pathways and regulation of carbohydrate, lipid, amino acid, and nucleotide biosynthesis and breakdown. The material is presented to build links to human biology and human disease. One semester of biology is recommended. Offered as BIOL 307, BIOL 407, and BIOL 407. Prereq: CHEM 223 and CHEM 224.

BIOL 408. Molecular Biology. 4 Units.
An examination of the flow of genetic information from DNA to RNA to protein. Topics include: nucleic acid structure; mechanisms and control of DNA, RNA, and protein biosynthesis; recombinant DNA; and mRNA processing and modification. Where possible, eukaryotic and prokaryotic systems are compared. Special topics include yeast as a model organism, molecular biology of cancer, and molecular biology of the cell cycle. Current literature is discussed briefly as an introduction to techniques of genetic engineering. Recommended preparation: BIOL 307. Offered as BIOL 308, BIOL 408, and BIOL 408. Prereq: BIOL 215 or BIOL 307.

BIOL 409. Biology Field Studies. 3 Units.
Intensive investigation of living organisms in a natural environment. Location of the field site may vary with each course offering, and may be either domestic or international. Topics covered include logistics, biodiversity, and current ecological, environmental, and social issues surrounding the specific ecosystem being studied. Time at the field site will be spent listening to resident lecturers, receiving guided tours, observing and identifying wild organisms in their natural habitat, and conducting a research project. The undergraduate version requires students to plan and conduct a group research project and present results independently. The graduate version requires students to plan, conduct, and present an independent research project. Instructor consent required to register. This course will fulfill a laboratory requirement of the B.A. in Biology. This course will fulfill an additional laboratory requirement of the B.S. in Biology. Course may be repeated for credit up to two times if traveling to a new destination. Offered as BIOL 309 and BIOL 409. Prereq: Graduate Standing.
BIOL 414. Taming the Tree of Life: Phylogenetic Comparative Methods—From Concept to Practical Application. 3 Units.

“Nothing in biology makes sense except in the light of evolution” – Dobzhansky. Biologists have long been fascinated by the diversity of life. Why are there so many species? Why are some of them similar and others divergent? How has evolution shaped ecological interactions, such as disease-host dynamics? The “tree of life” describes phylogenetic hypotheses for evolutionary history among species, and modern phylogenetic comparative methods allow us to incorporate the tree of life into statistical analyses. This course will introduce phylogenetic comparative methods, why they are needed to answer many biological questions, how they are conducted, and how they can be used to evaluate hypotheses. These methods can be used for any group of organisms, from humans and their diseases, to plants, animals, or fungi. These methods also can be used to address a broad suite of questions in biology, including biomedical, ecological, evolutionary, developmental, and neuromechanical questions. For example, issues of public health can be more deeply addressed using these tools. Students may bring their own data sets, or may use existing data sets, and will develop an independent research project using these tools. Undergraduates will present a poster at a public poster fair, as part of the requirements for the SAGES capstone. No prior experience with the R statistics language is necessary for this course. BIOL314 fulfills the requirements for an undergraduate capstone in biology. Offered as BIOL 314 and BIOL 414.

BIOL 415. Quantitative Biology Laboratory. 3 Units.

This course will apply a range of quantitative techniques to explore structure-function relations in biological systems. Using a case study approach, students will explore causes of impairments of normal function, will assemble diverse sets of information into a database format for the analysis of causes of impairment, will analyze the data with appropriate statistical and other quantitative tools, and be able to communicate their results to both technical and non-technical audiences. The course has one lecture and one lab per week. Students will be required to maintain a journal of course activities and demonstrate mastery of quantitative tools and statistical techniques. Graduate students will have a final project that applies these techniques to a problem of their choice. Offered as BIOL 315 and BIOL 415.

BIOL 416. Fundamental Immunology. 4 Units.

Introductory immunology providing an overview of the immune system, including activation, effector mechanisms, and regulation. Topics include antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity, innate versus adaptive immunity, cytokines, and basic molecular biology and signal transduction in B and T lymphocytes, and immunopathology. Three weekly lectures emphasize experimental findings leading to the concepts of modern immunology. An additional recitation hour is required to integrate the core material with experimental data and known immune mediated diseases. Five mandatory 90 minute group problem sets per semester will be administered outside of lecture and recitation meeting times. Graduate students will be graded separately from undergraduates, and 22 percent of the grade will be based on a critical analysis of a recently published, landmark scientific article. Offered as BIOL 316, BIOL 416, CLBY 416, PATH 316 and PATH 416. Prereq: Graduate standing.

BIOL 417. Cytokines: Function, Structure, and Signaling. 3 Units.

Regulation of immune responses and differentiation of leukocytes is modulated by proteins (cytokines) secreted and/or expressed by both immune and non-immune cells. Course examines the function, expression, gene organization, structure, receptors, and intracellular signaling of cytokines. Topic include regulatory and inflammatory cytokines, colony stimulating factors, chemokines, cytokine and cytokine receptor gene families, intracellular signaling through STAT proteins and tyrosine phosphorylation, clinical potential, and genetic defects. Lecture format using texts, scientific reviews and research articles. Recommended preparation: PATH 416 or equivalent. Offered as BIOL 417, CLBY 417, and PATH 417.

BIOL 418. Introductory Entomology. 4 Units.

The goal of this course is to discover that, for the most part, insects are not aliens from another planet. Class meetings will alternate; with some structured as lectures, while others are laboratory exercises. Sometimes we will meet at the Cleveland Museum of Natural History, or in the field to collect and observe insects. The 50 minute discussion meeting once a week will serve to address questions from both lectures and lab exercises. The students will be required to make a small but comprehensive insect collection. Early in the semester we will focus on collecting the insects, and later, when insects are gone for the winter, we will work to identify the specimens collected earlier. Students will be graded based on exams, class participation and their insect collections. Offered as BIOL 318 and BIOL 418. Prereq: BIOL 214, and BIOL 215, and BIOL 216.

BIOL 419. Applied Probability and Stochastic Processes for Biology. 3 Units.

Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419.
BIOL 421. Design and Analysis of Biological Experiments. 3 Units.
In this laboratory course, students will learn how to use a computer programming language (MATLAB) to design, execute, and analyze biological experiments. The course will begin with basic programming and continue to data output and acquisition, image analysis, and statistics. Students who are interested in carrying out research projects in any lab setting are encouraged to take this course and use the skills acquired to better organize and analyze their experiments. No prior programming knowledge is assumed. This course satisfies a laboratory requirement of the B.A. in biology. This course satisfies a laboratory or quantitative laboratory requirement of the B.S. in biology. Students will complete a final project on a topic of their choice; graduate students will be required to give an oral presentation of this project. Offered as BIOL 321 and BIOL 421. Counts for CAS Quantitative Reasoning Requirement. Prereq: Graduate standing.

BIOL 422. Sensory Biology. 3 Units.
The task of a sensory system is to collect, process, store, and transmit information about the environment. How do sensory systems convert information from the environment into neural information in an animal's brain? This course will explore the ecology, physiology, and behavior of the senses across the animal kingdom. We will cover introductory neurobiology and principles of sensory system organization before delving more deeply into vision, olfaction, audition, mechanosensation, and multi-modal sensory integration. For each sensory modality, we will consider how the sensory system operates and how its operation affects the animal's behavior and ecology. We will also explore the evolution of sensory systems and their specialization for specific behavioral tasks. Students will finish the course with a research project on a topic of their choice; graduate students will present this project to the class. Offered as BIOL 322 and BIOL 422. Prereq: Graduate standing.

BIOL 424. Introduction to Stem Cell Biology. 3 Units.
This discussion-based course will introduce students to the exciting field of stem cell research. Students will first analyze basic concepts of stem cell biology, including stem cell niche, cell quiescence, asymmetric cell division, cell proliferation and differentiation, and signaling pathways involved in these processes. This first part of the course will focus on invertebrate genetic models for the study of stem cells. In the second part of the course, students will search for primary research papers on vertebrate and human stem cells, and application of stem cell research in regenerative medicine and cancer. Finally, students will have the opportunity to discuss about ethical controversies in the field. Students will rotate in weekly presentations, and will write two papers during the semester. Students will improve skills on searching and reading primary research papers, gain presentation skills, and further their knowledge in related subjects in the fields of cell biology, genetics and developmental biology. This course may be used as a cell/molecular subject area elective for the B.A. and B.S. Biology degrees. Offered as BIOL 324 and BIOL 424. Prereq: Graduate standing.

BIOL 426. Genetics. 3 Units.
Transmission genetics, nature of mutation, microbial genetics, somatic cell genetics, recombinant DNA techniques and their application to genetics, human genome mapping, plant breeding, transgenic plants and animals, uniparental inheritance, evolution, and quantitative genetics. Offered as BIOL 326 and BIOL 426.

BIOL 427. Functional Genomics. 3 Units.
In this course, students will learn how to access and use genomics data to address questions in cell biology, development and evolution. The genome of Drosophila melanogaster will serve as a basis for exploring genome structure and learning how to use a variety of available software to identify similar genes in different species, predict protein sequence and functional domains, design primers for PCR, analyze cis-regulatory sequences, access microarray and RNAseq databases, among others. Classes will be in the format of short lectures, short oral presentations made by students and hands-on experimentation using computers. Discussions will be centered in primary research papers that used these tools to address specific biological questions. A final project will consist of a research project formulated by a group of 2-3 students to test a hypothesis formulated by the students using the bioinformatics tools learned in the course. Graduate students will be required to make additional presentations of research papers. They also will have additional questions in exams and a distinct project requirement on written assignments. This course satisfies a laboratory requirement of the B.A. in Biology. This course satisfies a laboratory or quantitative laboratory requirement of the B.S. in Biology. Offered as BIOL 327 and BIOL 427. Prereq: Graduate standing.

BIOL 428. Plant Genomics and Proteomics. 3 Units.
The development of molecular tools has impacted agriculture as much as human health. The application of new techniques to improve food crops, including the development of genetically modified crops, has also become controversial. This course covers the nature of the plant genome and the role of sequenced-based methods in the identification of the genes. The application of the whole suite of modern molecular tools to understand plant growth and development, with specific examples related agronomically important responses to biotic and abiotic stresses, is included. The impact of the enormous amounts of data generated by these methods and their storage and analysis (bioinformatics) is also considered. Finally, the impact on both the developed and developing world of the generation and release of genetically modified food crops will be covered. Recommended preparation: BIOL 326. Offered as BIOL 328 and BIOL 428.

BIOL 431. Statistical Methods I. 3 Units.
Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs. First part of year-long sequence. Offered as ANAT 431, BIOL 431, CRSP 431, PQHS 431 and MPHP 431.

BIOL 432. Statistical Methods II. 3 Units.
Methods of analysis of variance, regression and analysis of quantitative data. Emphasis on computer solution of problems drawn from the biomedical sciences. Design of experiments, power of tests, and adequacy of models. Offered as BIOL 432, PQHS 432, CRSP 432 and MPHP 432. Prereq: PQHS/EPBI 431 or equivalent.

BIOL 434. Structural Biology. 3 Units.
Introduces basic chemical properties of proteins and discusses the physical forces that determine protein structure. Topics include: the elucidation of protein structure by NMR and by X-ray crystallographic methods; the acquisition of protein structures from data bases; and simple modeling experiments based on protein structures. Offered as BIOL 334, BIOL 334, BIOL 434, and BIOL 434.

BIOL 436. Aquatic Biology. 3 Units.
Physical, chemical, and biological dynamics of lake ecosystems. Factors governing the distribution, abundance, and diversity of freshwater organisms. Offered as BIOL 336 and BIOL 436.
BIOL 438. Ichthyology. 4 Units.
Biology of fishes. Students will develop fundamental understanding of the evolutionary history and systematics of fishes to provide a context within which they can address aspects of biology including anatomy, physiology (e.g., in species that change sex; osmoregulation in freshwater vs. saltwater), and behavior (e.g., visual, auditory, chemical, electric communication; social structures), ecology, and evolution (e.g., speciation). We will explore the biodiversity of fishes around the world, with emphasis on Ohio species, by examining preserved specimens, observing captive living specimens, and observing, capturing, and identifying wild fishes in their natural habitats. Practical applications will be emphasized, such as aquaculture, fisheries management, and biomedical research. Course will conclude with an analysis of the current global fisheries crisis that has resulted from human activities. There will be many field trips and networking with the Cleveland Metroparks Zoo, the Cleveland Museum of Natural History, and local, state, and federal government agencies. Some classes meet at the Cleveland Museum of Natural History. This course satisfies a laboratory requirement of the B.A. and B.S. in biology. The graduate version of the course requires a research project and term paper. Offered as BIOL 338 and BIOL 438. Prereq: Graduate Standing.

BIOL 442. Parasitology. 3 Units.
This course will introduce students to classical and current parasitology. Students will discuss basic principles of parasitology, parasite life cycles, host-parasite interaction, therapeutic and control programs, epidemiology, and ecological and societal considerations. The course will explore diverse classes of parasitic organisms with emphasis on protozoan and helminthic diseases and the parasites’ molecular biology. Group discussion and selected reading will facilitate further integrative learning and appreciation for parasite biology. This course counts as an elective in the cell/molecular biology subject area for the Biology B.A. and B.S. degrees. Offered as BIOL 342 and BIOL 442. Prereq: Graduate standing and consent of instructor.

BIOL 443. Microbiology. 3 Units.
The subject will be approached both as a basic biological science that studies the molecular and biochemical processes of cells and viruses, and as an applied science that examines the involvement of microorganisms in human disease as well as in workings of ecosystems, plant symbioses, and industrial processes. The course is divided into four major areas: bacteria, viruses, medical microbiology, and environmental and applied microbiology. Offered as BIOL 343 and BIOL 443.

BIOL 445. Mammal Diversity and Evolution. 4 Units.
This course focuses on the anatomical and taxonomic diversity of mammals in an evolutionary context. The emphasis is living (extant) mammals, but extinct mammals are also discussed. By the end of the course, students will be able to: (1) describe the key anatomical and physiological features of mammals; (2) name all orders and most families of living mammals; (3) identify a mammal skull to order and family; (4) understand how to create and interpret a phylogenetic tree; (5) appreciate major historical patterns in mammal diversity and biogeography as revealed by the fossil record. Two student-led seminars and one lab each week. Most labs will take place at the Cleveland Museum of Natural History. One weekend field trip to Cleveland Metroparks Zoo. This course satisfies a laboratory requirement for the biology major. Offered as ANAT 445, BIOL 345, and BIOL 445. Prereq: BIOL 214.

BIOL 451. Principles of Ecology. 3 Units.
This lecture course explores spatial and temporal relationships involving organisms and the environment at individual, population, and community levels. An underlying theme of the course will be neo-Darwinian evolution through natural selection with an emphasis on organismal adaptations to abiotic and biotic environments. Studies and models will illustrate ecological principles, and there will be some emphasis on the applicability of these principles to ecosystem conservation. Students taking the graduate level course will prepare a grant proposal in which hypotheses will be based on some aspect of ecological theory. Offered as BIOL 351 and BIOL 451.

BIOL 451L. Principles of Ecology Laboratory. 2 Units.
Students in this laboratory course will conduct a variety of ecological investigations that are designed to examine relationships involving organisms and the environment at individual, population, and community levels. Descriptive and hypothesis-driven investigations will take place at Case Western Reserve University’s Squire Valleypeve Farm, in both field and greenhouse settings. The course is designed to explore as well as test a variety of ecological paradigms. Students taking the graduate level course will prepare a grant proposal in which hypotheses will be based on a select number of lab investigations. This course satisfies a laboratory requirement for biology majors. Recommended preparation for BIOL 451L: prior or concurrent enrollment in BIOL 451. Offered as BIOL 351L and BIOL 451L.

BIOL 452. Ecology and Evolution of Infectious Diseases. 3 Units.
This course explores the effects of infectious diseases on populations of hosts, including humans and other animals. We will use computer models to study how infectious diseases enter and spread through populations, and how factors like physiological and behavioral differences among host individuals, host and pathogen evolution, and the environment affect this spread. Our emphasis will be on understanding and applying quantitative models for studying disease spread and informing policy in public health and conservation. To that end, computer labs are the central component of the course. This course satisfies a laboratory requirement of the B.A. in biology. This course satisfies a laboratory or quantitative laboratory requirement of the B.S. in biology. Offered as BIOL 352 and BIOL 452. Prereq: Graduate standing.

BIOL 453. Ecophysiology of Global Change. 3 Units.
Global change is an emerging threat to human health and economic stability. Rapid changes in climate, land use, and prevalence of non-native species generate novel conditions outside the range of typical conditions under which organisms evolved. Already we are witnessing the global redistribution of plants and animals, changes in the timing of critical life cycle events, and in some cases local extinction of populations. This course explores the impacts of global change on biological systems at levels from individuals to ecosystems; among animals, plants and microbes; across ecological to evolutionary timescales; and from local to global spatial scales. Throughout, physiology is emphasized as a core driver of biological responses to global change. Traditional lectures will be accompanied by discussions of primary literature articles. The laboratory component will involve the development of an independent project at the University Farm, and dissemination of results through traditional (e.g. written paper) and new (e.g. podcast) media. This class will fulfill a laboratory requirement of the B.A. in Biology. This class will fulfill an additional laboratory requirement of the B.S. in Biology. Offered as BIOL 353 and BIOL 453. Prereq: Graduate Standing.
BIOL 457. Conversations on Protein Structure and Function. 2 Units.
The goal of this course is to supplement the short and basic presentation of Proteins in C3MB by lectures and discussions for students with backgrounds in physical-chemical sciences or students who already have a good basic background in protein science. The course presents an overview of Protein structure/function. Following an introduction to the principles of protein structure, the physical basis of protein folding and stability, and a brief overview of structural and bioinformatics approaches to protein analysis is presented. Typically two lecture/discussion style presentations are followed by a student lead journal club on recent high profile papers. The way the Journal club is done is that one student presents a paper (background and figures in powerpoint slides) while presentation of the main figures is shared between the class. Papers and Figures will be assigned by instructor. Typically two papers will be presented per session. Offered as PHOL 456 and BIOL 457.

BIOL 458. Animal Behavior. 4 Units.
Ultimately the success or failure (i.e., life or death) of any individual animal is determined by its behavior. The ability to locate and capture food, avoid being food, acquiring and defending territory, and successfully passing your genes to the next generation, are all dependent on complex interactions between an animal’s design, environment and behavior. This course will be an integrative approach emphasizing experimental studies of animal behavior. You will be introduced to state-of-the-art approaches to the study of animal behavior, including neural and hormonal mechanisms, genetic and developmental mechanisms and ecological and evolutionary approaches. We will learn to critique examples of current scientific papers, and learn how to conduct observations and experiments with real animals. We will feature guest appearances by the Curator of Research from the Cleveland MetroParks Zoo and visits to working animal behavior research labs here at CWRU. Group discussions and writing will be emphasized. This course satisfies a laboratory requirement for biology majors. Offered as BIOL 358 and BIOL 458.

BIOL 462. Principles of Developmental Biology. 3 Units.
The descriptive and experimental aspects of animal development. Gametogenesis, fertilization, cleavage, morphogenesis, induction, differentiation, organogenesis, growth, and regeneration. Students taking the graduate-level course will prepare an NIH-format research proposal as the required term paper. Offered as BIOL 362, BIOL 462 and ANAT 462.

BIOL 463. Experimental Developmental Biology. 3 Units.
This laboratory course will teach concepts and techniques in developmental biology. Emphasis will be on the mechanisms that pattern the embryo during development and how these mechanisms are explored using molecular, cellular, and genetic approaches. A term research paper is required. Students taking the graduate level course will prepare a grant proposal. One laboratory and one lecture per week. Offered as BIOL 363 and BIOL 463.

BIOL 464. Research Methods in Evolutionary Biology. 3 Units.
The process of evolution explains not only how the present diversity of life on earth has formed, but also provides insights into current pressing issues today, including the spread of antibiotic resistance, the causes of geographic variation in genetic diseases, and explanations for modern patterns of extinction risk. Students in Research Methods in Evolutionary Biology will be introduced to several of the major research approaches of evolutionary biology, including methods of measuring natural selection on the phenotypic and genotypic levels, quantifying the rate of evolution, reconstructing evolutionary relationships, and assessing the factors that affect rates of speciation and extinction. The course will consist of a combination of interactive lectures, in-class problem solving and data analysis, and the discussion of peer-reviewed scientific papers. Grades are based on participation in class, discussions and written summaries of published papers, in-class presentations, and two writing assignments. Offered as BIOL 364 and BIOL 464. Counts as SAGES Departmental Seminar. Prereq: BIOL 214, BIOL 216, BIOL 251.

BIOL 465. Evo-Devo:Evolution of Body Plans and Pathologies. 3 Units.
This discussion-based course offers a detailed introduction to Evolutionary Developmental Biology. The field seeks to explain evolutionary events through the mechanisms of Developmental Biology and Medical Genetics. The course is structured into different modules. First we will look at the developmental genetic mechanisms that can cause variation and medical pathologies. Then we focus on how alterations of these mechanisms can generate novel structural changes. We will then examine a few areas of active debate, where Evo-Devo is attempting to solve major problems in evolutionary biology and congenital birth defects. We will conclude with two writing assignments. Students will be required to present, read, and discuss primary literature in each module. This course is offered as a SAGES Departmental Seminar and fulfills a Cell and Molecular breadth requirement of the BA and BS in Biology. Offered as BIOL 365 and BIOL 465. Counts as SAGES Departmental Seminar.

BIOL 467. Biorobotics Team Research. 3 Units.
Many exciting research opportunities cross disciplinary lines. To participate in such projects, researchers must operate in multidisciplinary teams. The Biorobotics Team Research course offers a unique capstone opportunity for undergraduate students to utilize skills they developed during their undergraduate experience while acquiring new teaming skills. A group of eight students form a research team under the direction of two faculty leaders. Team members are chosen from appropriate majors through interviews with the faculty. They will research a biological mechanism or principle and develop a robotic device that captures the actions of that mechanism. Although each student will cooperate on the team, they each have a specific role, and must develop a final paper that describes the research generated on their aspect of the project. Students meet for one class period per week and two 2-hour lab periods. Initially students brainstorm ideas and identify the project to be pursued. They then acquire biological data and generate robotic designs. Both are further developed during team meetings and reports. Final oral reports and a demonstration of the robotic device occur in week 15. Offered as BIOL 377, EMAE 377, BIOL 467, and EMAE 477. Counts as SAGES Senior Capstone.
BIOL 468. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467.

BIOL 471. Foundations of Advanced Ecology. 3 Units.
Advanced ecology, including discussion of the classic literature, in-depth study of key terms and concepts, applications of these foundational ideas to the modern literature, and current and future directions in the field. Intended for graduate students who have already taken undergraduate ecology (BIOL 351/451 or equivalent). Prereq: Graduate standing.

BIOL 472. Foundations of Advanced Evolution. 3 Units.
Advanced evolutionary biology, including discussion of the classic literature, in-depth study of key terms and concepts, applications of these foundational ideas to the modern literature, and current and future directions in the field. Intended for graduate students who have already taken undergraduate evolution. Prereq: Graduate standing.

BIOL 473. Introduction to Neurobiology. 3 Units.
How nervous systems control behavior. Biophysical, biochemical and molecular biological properties of nerve cells, their organization into circuitry, and their function within networks. Emphasis on quantitative methods for modeling neurons and networks, and on critical analysis of the contemporary technical literature in the neurosciences. Term paper required for graduate students. This course satisfies a lab requirement for the B.A. in Biology, and a Quantitative Laboratory requirements for the B.S. in Biology. Offered as BIOL 373, BIOL 473, and NEUR 473.

BIOL 474. Neurobiology of Behavior. 3 Units.
In this course, students will examine how neurobiologists interested in animal behavior study the linkage between neural circuitry and complex behavior. Various vertebrate and invertebrate systems will be considered. Several exercises will be used in this endeavor. Although some lectures will provide background and context on specific neural systems, the emphasis of the course will be on classroom discussion of specific journal articles. In addition, students will each complete a project in which they will observe some animal behavior and generate both behavioral and neurobiological hypotheses related to it. In lieu of examinations, students will complete three written assignments, including a theoretical grant proposal, a one-page Specific Aims paper related to the project, and a final project paper. These assignments are designed to give each student experience in writing biologically-relevant documents. Classroom discussions will help students understand the content and format of each type document. They will also present their projects orally to the entire class. Offered as BIOL 374, BIOL 474 and NEUR 474. Counts as SAGES Departmental Seminar. Prereq: Graduate Standing.

BIOL 476. Neurobiology Laboratory. 3 Units.
Introduction to the basic laboratory techniques of neurobiology. Intracellular and extracellular recording techniques, forms of synaptic plasticity, patch clamping, immunohistochemistry and confocal microscopy. During the latter weeks of the course students will be given the opportunity to conduct an independent project. One laboratory and one discussion session per week. Recommended preparation for BIOL 476 and NEUR 476: BIOL 216. Offered as BIOL 376, BIOL 476 and NEUR 476.

BIOL 478. Computational Neuroscience. 3 Units.
Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EEC 478, MATH 478 and NEUR 478.

BIOL 479. Transformative Animal Models in Modern Biology. 3 Units.
Animal models are extremely important in the study of biology and in modern medicine. They allow us to determine fundamental biological mechanisms and cellular and molecular causes of disease. There is logic to how each animal model has found its place in the menagerie of accepted animal models. Certain animal models allow us to test particular hypotheses that may not be possible to address in other animals. Moreover, some animal models are more relevant than others to studying a particular human disease. This seminar-based course will focus on animal models that either are effective at modeling human disease, approach relevant neurobiological questions, or play a role in translational medicine. The course will focus on mammalian and non-mammalian animal models that are important to biomedical research, including the primate, mouse, zebrafish, and roundworm. Comparisons between popular animal models will be made. This course fulfills the Organismal breadth requirement of the BA and BS in Biology. Offered as BIOL 379 and BIOL 479. Counts as SAGES Departmental Seminar. Prereq: Graduate Standing.

BIOL 480. Physiology of Organ Systems. 4 Units.
Our intent is to expand the course from the current 3 hours per week (1.5 hour on Monday and Wednesday) to 4 hours per week (1.5 hours on Monday and Wednesday plus 1 hour on Friday). Muscle structure and Function, Myasthenia gravis and Sarcopecia; Central Nervous System, (Synaptic Transmission, Sensory System, Autonomic Nervous System, CNS circuits, Motor System, Neurodegenerative Diseases, Paraplegia and Nerve Compression); Cardiovascular Physiology (Regulation of Pressure and flow; Circulation, Cardiac Cycle, Electrophysiology, Cardiac Function, Control of Cardiovascular function, Hypertension); Hemorragay, Cardiac Hypertrophy and Fibrillation; Respiration Physiology (Gas Transport and Exchange, Control of Breathing, Acid/base regulation, Cor Pulmonaris and Cystic Fibrosis, Sleeping apnea and Emphysema); Renal Physiology (Gomerular Filtration, Tubular Function/transport, Glomerulonephritis, Tubulopaties); Gastro-Intestinal Physiology (Gastric motility, gastric function, pancreas and bile function, digestion and absorption, Liver Physiology, Panreatitis, Liver Disease and cirrhosis); Endocrine Physiology (Thyroid, Adrenal glands, endocrine pancreas, Parathyroid, calcium sensing receptor, Cushing and diabetes, Reproductive hormones, eclampsia); Integrative Physiology (Response to exercise, fasting and feeding, aging). For all the classes, the students will receive a series of learning objectives by the instructor to help the students address and focus their attention to the key aspects of the organ physiology (and psychopathology). The evaluation of the students will continue to be based upon the students’ participation in class (60% of the grade) complemented by a mid-term and a final exam (each one accounting for 20% of the final grade). Offered as BIOL 480 and PHOL 480.
BIOL 482. Drugs, Brain, and Behavior. 3 Units.
This course is concerned with the mechanisms underlying neurochemical signaling and the impact of drugs on those mechanisms. The first half of the course emphasizes the fundamental mechanisms underlying intra- and extracellular communication of neurons and the basic principles of how drugs interact with the nervous system. The second half of the course emphasizes understanding the neural substrates of disorders of the nervous system, and the mechanisms underlying the therapeutic effects of drugs at the cellular and behavioral levels. This course will consist of lectures designed to give the student necessary background for understanding these basic principles and class discussion. The class discussion will include viewing video examples of behavioral effects of disorders of the nervous system, and analysis of research papers. The goal of the class discussions is to enhance the critical thinking skills of the student and expose the student to contemporary research techniques. Offered as BIOL 382, BIOL 482, and NEUR 482.

BIOL 491. Contemporary Biology and Biotechnology for Innovation I. 3 Units.
The first half of a two-semester sequence providing an understanding of biology as a basis for successfully launching new high-tech ventures. The course will examine physical limitations to present technologies and the use of biology to identify potential opportunities for new venture creation. The course will provide experience in using biology in both identification of incremental improvements and as the basis for alternative technologies. Case studies will be used to illustrate recent commercially successful (and unsuccessful) biotechnology-based venture creation and will illustrate characteristics for success.

BIOL 492. Contemporary Biology and Biotechnology for Innovation II. 3 Units.
Continuation of BIOL 491 with an emphasis on current and prospective opportunities for Biotechnology Entrepreneurship. Longer term opportunities for Biotechnology Entrepreneurship in emerging areas including (but not limited to) applications of DNA sequence information in medicine and agriculture; energy and the environment; biologically-inspired robots. Recommended preparation: BIOL 491 or consent of department.

BIOL 493. Feasibility and Technology Analysis. 3 Units.
This course provides the tools scientists need to determine whether a technology is ready for commercialization. These tools include (but are not limited to): financial analysis, market analysis, industry analysis, technology analysis, intellectual property protection, the entrepreneurial process and culture, an introduction to entrepreneurial strategy and new venture financing. Deliverables will include a technology feasibility analysis on a possible application in the student’s scientific area. Offered as BIOL 493, CHEM 493, and PHYS 493.

BIOL 495. Introduction to Graduate School in the Biological Sciences. 1 Unit.
This course will help incoming Biology MS and Ph.D. students navigate their way through graduate school and participate in the scientific process. Students in the Biology graduate program will be strongly encouraged to take this course in their first year. This will be a skill-based course that will become part of their academic toolbox. In addition, there will be sessions to offer general tips for life in graduate school. Prereq: Graduate Standing.

BIOL 497. Molecular Phylogenetics. 4 Units.
This course is designed to teach the theory and practice of molecular based phylogenetics with attention to evolutionary analysis through lecture, readings, discussion, and a quantitative laboratory section. A comprehensive overview of the history of systematics and morphology based phylogenetics will help familiarize students with the theory, methods, and character analysis frameworks used in current genetic based approaches. A laboratory section of the course will provide working knowledge in designing and carrying out an original phylogenetics project beginning with data procurement to writing a research manuscript. Through readings and discussions of research articles as well as presented content, the relevant course material will be utilized in practice by students analyzing their project data sets. The semester-long research project will take students through the process of building a data set, aligning sequences, reconstructing phylogenies, conducting evolutionary analyses, and interpreting and writing results as a scientific manuscript. In addition, students will orally present their research proposal as well as the final research project. Undergraduate students will work in teams of two on the research project component of the course and independently throughout the other course components (discussions). Graduate students will work independently and have an extra assignment. This course satisfies a laboratory requirement of the B.A. in Biology. This course satisfies a laboratory or quantitative laboratory requirement of the B.S. in Biology. Offered as: BIOL 397 and BIOL 497. Prereq: Graduate Standing.

BIOL 498. Modern Human Biological Variation. 3 Units.
The objectives of this course are to provide students with an introduction to human biological variation and to understand the variation within an evolutionary framework through lecture, readings, discussion, and labs. We will examine the patterns of morphological and genetic variation in modern human populations and discuss the evolutionary explanations for the observed patterns. In order to do this, we will first build a solid foundation in the scientific method, population genetics, and evolutionary theory before exploring the adaptive significance of the observed variation. A major component of the class will be the discussion of the social and health implications of these patterns of biological variation, particularly in the construction and application of the concept of race and its use in medicine. There are three units to the course. Unit 1 focuses on the fundamentals to understanding biological variation, we will cover basic population genetics, evolution, and the human fossil record. Unit 2 concentrates on surveying modern human biological variation, examining both morphological and genetic traits, and why these variations exist. Unit 3 examines how race is constructed using population-based biological differences, its validity, and the implications for health and medicine. This course fulfills the Population and Ecology breadth requirement of the B.A. and B.S. in Biology. Offered as BIOL 398 and BIOL 498. Prereq: Graduate Standing.

BIOL 549. Mathematical Life Sciences Seminar. 1 - 3 Units.
Continuing seminar on areas of current interest in the applications of mathematics to the life sciences. Allows graduate and advanced undergraduate students to become involved in research. Topics will reflect interests and expertise of the faculty and may include topics in mathematical biology, computational neuroscience, mathematical modeling of biological systems, models of infectious diseases, computational cell biology, mathematical ecology and mathematical biomedicine broadly construed. May be taken more than once for credit.
BIOL 599. Advanced Independent Study for Graduate Students. 1 - 3 Units.
Independent study of advanced topics in biology under the supervision of a biology faculty member. Registration requires submission of a proposal for a project or study and approval of the department.

BIOL 601. Research. 1 - 9 Units.

BIOL 651. Thesis M.S.. 1 - 9 Units.

BIOL 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

**Department of Chemistry**

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www.case.edu/artsci/chem
Phone: 216.368.3622; Fax: 216.368.3006
John D. Protasiewicz, Department Chair
john.protasiewicz@case.edu

The Department of Chemistry is the largest department representing the chemical sciences at Case Western Reserve University. It consists of 18 faculty members, 16 associated faculty, about 14 postdoctoral associates, approximately 90 graduate students, and over 150 undergraduate students majoring in chemistry. The department offers undergraduate and graduate degree programs leading to the Bachelor of Arts, Bachelor of Science, Master of Science, and Doctor of Philosophy.

The general focus of chemistry is on (1) understanding the basic properties of matter, and (2) employing this knowledge in the design, synthesis, and characterization of materials with novel and useful properties. The various degree programs strive to develop all aspects of the student's chemical knowledge through a broad range of lecture and laboratory courses.

Chemical research is an integral part of the department's activities: over $3 million of federal, state, and private research support flows into the department each year. State-of-the-art research facilities are available to both graduate and undergraduate students. Undergraduates are encouraged to participate in research projects with individual faculty members in order to expand their hands-on training, problem-solving skills, and understanding of the scientific method as applied in chemical research. These research projects typically involve interchange and collaboration across all levels of experience and may also involve scientists from other departments and institutions.

Chemistry is often referred to as "the central science" because of its key role in interdisciplinary studies. Correspondingly, a degree in chemistry affords a broad range of employment opportunities. Chemists can direct their talents to specialized problems of applied research, or they can choose to delve into fundamental investigations. A degree in chemistry can cover the spectrum of chemical specialties, from biochemistry to interstellar chemistry. The degree also provides valuable preparation for other professions, such as medicine, dentistry, and law.

The American Chemical Society (http://www.acs.org), with more than 160,000 members, is the major professional society in the United States for practicing chemists. Both undergraduate and graduate students may join the society.

**Facilities**
The department's facilities for experimental and theoretical research are modern and extensive. They include diverse major instruments for use by faculty and students, as well as specialized equipment serving individual research groups. Shared instrumentation includes 400- and 600-MHz NMR spectrometers, ultrafast laser systems in the Center for Chemical Dynamics, and a cyber-enabled X-ray crystallographic facility.

Other departmental instrumentation includes equipment for laser Raman spectroscopy, GC-MS and LC-MS/MS mass spectrometers, calorimeters, stopped-flow kinetics instrumentation, a circular dichroism spectrometer, an analytical ultracentrifuge, and equipment for electrochemical measurements. Access to very high-field NMR instrumentation is available on campus at the Cleveland Center for Membrane Structural Biology (CCMSB), which is equipped with numerous 500- to 900-MHz NMR spectrometers for solution and solid-state measurements. The chemistry department's computers are part of the campus-wide fiber optic communications network operated by Information Technology Services, and the entire University Circle area offers wireless access. In addition to the full complement of software, Internet, and library database services offered by the university, connections to off-site databases, such as SciFinder and Ohio Supercomputer Center, are available to departmental users.

The department uses some of the foremost equipment available in high-resolution nuclear magnetic resonance spectroscopy and in tunable laser spectroscopy. Work on various aspects of chemistry as studied by these techniques is recognized throughout the world.

** Majors**
The Department of Chemistry offers three curricula for undergraduate majors, leading to a Bachelor of Science (BS) degree in chemistry, Bachelor of Arts (BA) degree in chemistry, or Bachelor of Arts (BA) degree in chemical biology.

**Bachelor of Science in Chemistry Program**
The BS program in chemistry is designed for students who seek professional careers in the chemical sciences and is certified by the American Chemical Society. The BS curriculum provides a rigorous background in chemistry, yet offers considerable flexibility in the senior year in the choice of electives, allowing BS majors to pursue areas of chemistry of particular interest to them in greater depth. At least three units of research (CHEM 397 / CHEM 398) are required, and up to nine units of research may be credited toward the degree.

**Total Units Required for Graduation: 120**

**Chemistry BS - Required Chemistry Courses**

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<th>First Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Principles of Chemistry I (CHEM 105)</td>
<td>3</td>
<td></td>
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<tr>
<td>Principles of Chemistry Laboratory (CHEM 113)</td>
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<tr>
<td>Principles of Chemistry II (CHEM 106)</td>
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<td>Year Total:</td>
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<th>Second Year</th>
<th>Units</th>
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<tr>
<td>Quantitative Analysis Laboratory (CHEM 304)</td>
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<td>Foundations of Analytical Chemistry (CHEM 310)</td>
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<td>Organic Chemistry I (CHEM 323)</td>
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<tr>
<td>Laboratory Methods in Organic Chemistry (CHEM 322)</td>
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Organic Chemistry II (CHEM 324) 3
Year Total: 8 6

**Third Year**

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<th>Units</th>
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<tr>
<td>Inorganic Chemistry I (CHEM 311)</td>
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<td>Laboratory Methods in Inorganic Chemistry (CHEM 331)</td>
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<td>Physical Chemistry I (CHEM 335)</td>
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<td>Laboratory Methods in Physical Chemistry (CHEM 332)</td>
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<td>Physical Chemistry II (CHEM 336)</td>
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<td>Chemistry Elective (300-level, see text below)</td>
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**Fourth Year**

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<td>Research Requirement:</td>
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<tr>
<td>Undergraduate Research (CHEM 397) or Undergraduate Research/Senior Capstone Project (CHEM 398)</td>
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<tr>
<td>Biochemistry Requirement (one of the following):</td>
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<tr>
<td>Introductory Biochemistry I (CHEM 328) (spring, 3 units)</td>
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<tr>
<td>Biochemistry II: Living Systems (CHEM 329) (fall, 3 units)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 307) (4 units)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry Elective (300-level, see text below)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical Electives (see text below)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>6-10</td>
<td>9</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 55-59

### Chemistry BS - Additional Required Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus III</td>
</tr>
<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
</tr>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
</tr>
<tr>
<td>PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
</tr>
<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
</tr>
<tr>
<td>or PHYS 221</td>
<td>Introduction to Modern Physics</td>
</tr>
</tbody>
</table>

The chemistry elective may be any chemistry department course at the 300 level or above which is not part of the "core set," or selected courses with a strong chemistry content at the 300 level or above from other science departments. Only three units of CHEM 397 may be applied to a chemistry elective.

The technical electives may be chosen more widely from any of the physical sciences, math, or engineering courses. An additional six units of CHEM 397 may be taken as technical electives. Further additional units of CHEM 397 may be taken as free electives. Students may wish to group their electives into "tracks" of specialization in order to tailor their degree to a particular area of chemistry.

BS majors who plan to go on to graduate study may elect to take advanced courses in:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 412</td>
<td>Advanced Inorganic Chemistry I</td>
</tr>
<tr>
<td>CHEM 421</td>
<td>Advanced Organic Chemistry I</td>
</tr>
<tr>
<td>CHEM 422</td>
<td>Advanced Organic Chemistry II</td>
</tr>
<tr>
<td>CHEM 435</td>
<td>Synthetic Methods in Organic Chemistry</td>
</tr>
<tr>
<td>CHEM 405</td>
<td>Chemical Kinetics</td>
</tr>
<tr>
<td>CHEM 407</td>
<td>Chemical Thermodynamics</td>
</tr>
<tr>
<td>CHEM 446</td>
<td>Quantum Mechanics I</td>
</tr>
</tbody>
</table>

Students can also elect to take other graduate offerings. Interdisciplinary strengths can be achieved by selecting technical electives in biochemistry, biomedical engineering, chemical engineering, macromolecular science, and materials science as well as in biology; earth, environmental, and planetary sciences; mathematics, applied mathematics, and statistics; and physics.

The BA program in chemistry is intended for pre-professional students who plan careers in medicine, dentistry, veterinary medicine, pharmacy, or in other fields for which a baccalaureate degree in chemistry provides appropriate training. BA majors may supplement their required courses with additional chemistry courses or may utilize the curriculum's flexibility to develop an interdisciplinary program of their choice. Many chemistry BA majors participate in undergraduate research within the Department of Chemistry (CHEM 397 / CHEM 398) or in other science departments, including those in the medical school.

Total Units Required for Graduation: 120

### Chemistry BA - Required Chemistry Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
</tr>
<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
</tr>
<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
</tr>
</tbody>
</table>

Year Total: 5
Bachelor of Arts in Chemical Biology Program

The BA program in chemical biology is intended for pre-professional students who plan careers in medicine, dentistry, veterinary medicine, pharmacy, or for individuals seeking careers that utilize chemistry to solve problems affecting living systems. A key component of the major is the flexibility imparted by fewer required courses and the integration of six credit hours of technical electives. Many chemical biology BA majors participate in undergraduate research within the Department of Chemistry (CHEM 397 / CHEM 398) or in other science departments, including those in the medical school.

Total Units Required for Graduation: 120

Chemical Biology BA - Required Chemistry Courses

First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
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<tr>
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<tr>
<td>5</td>
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Second Year

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
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Third Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td>8</td>
<td>6</td>
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</table>

Fourth Year

<table>
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<th>Units</th>
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<tbody>
<tr>
<td>6</td>
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</tr>
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</table>

Electives

Year Total:

Total Units in Sequence: 32-33

* CHEM 322 is offered in spring only, and may be substituted in place of both CHEM 233 and CHEM 234.

Chemistry BA - Additional Required Courses

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
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<tr>
<td>4</td>
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<td>8</td>
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</tbody>
</table>

Fourth Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td>3-6</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 36-43

* CHEM 322 is offered in spring only, and may be substituted in place of both CHEM 233 and CHEM 234. Only one semester of organic chemistry laboratory is required for our chemical biology BA program. However, some medical schools require two semesters of organic lab, so students should plan accordingly.

The technical electives may be chosen more widely from any of the physical sciences, math, or engineering courses. A maximum of six units of CHEM 397 may be taken as technical electives. Further additional units of CHEM 397 may be taken as free electives. Students may wish to group...
their electives into “tracks” of specialization in order to tailor their degree to a particular area of chemistry.

Chemical Biology BA - Additional Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 214L</td>
<td>Genes, Evolution and Ecology Lab</td>
<td>1</td>
</tr>
<tr>
<td>BIOL 215</td>
<td>Cells and Proteins</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 215L</td>
<td>Cells and Proteins Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td></td>
</tr>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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</tr>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci</td>
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<tr>
<td>or MATH 121</td>
<td>Calculus for Science and Engineering I</td>
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</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Units</td>
<td>24</td>
</tr>
</tbody>
</table>

Departmental Honors

Chemistry majors who have excellent academic records may participate in the Honors in Chemistry program. To graduate with honors in chemistry, a student must satisfy the following requirements:

1. A combined grade point average of 3.50 in chemistry, physics, and mathematics and an overall grade point average of 3.20
2. A minimum of six units of Undergraduate Research (CHEM 397), or chemical research done under another course number with departmental approval
3. A thesis approved by the department’s undergraduate affairs committee based on the level of research, quality of the manuscript, and chemical content

Teacher Licensure in Chemistry

The chemistry department offers a special option for undergraduate students who wish to pursue a chemistry major and a career in teaching. The Adolescent to Young Adult (AYA) Teacher Education Program in Physical Sciences prepares CWRU students to receive an Ohio Teaching License for grades 7-12. Students declare a second major in education—which involves 34 hours in education and practicum requirements—and complete a planned sequence of chemistry content course work within the context of the BA chemistry major. The program is designed to offer several unique features not found in other programs and to place students in mentored teaching situations throughout their teacher preparation career. This small, rigorous program is designed to capitalize on the strengths of CWRU’s chemistry department, its Teacher Education Program, and the relationships the university has built with area schools.

Chemistry Minor

Students may complete a minor in chemistry, defined as one year of freshman chemistry (including laboratory); two additional three-unit lecture courses; and two additional laboratory or approved courses. A recommended sequence would include:

Course List

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 323</td>
<td>Organic Chemistry I</td>
<td></td>
</tr>
<tr>
<td>CHEM 224</td>
<td>Introductory Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 324</td>
<td>Organic Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 233</td>
<td>Introductory Organic Chemistry Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 234</td>
<td>Introductory Organic Chemistry Laboratory II</td>
<td>2</td>
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<tr>
<td></td>
<td>Total Units</td>
<td>18</td>
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</table>

Other sequences may be followed after consultation with the Department of Chemistry.

Graduate Programs

Master of Science Programs

The MS degree in chemistry may be obtained by completing (1) a program that includes the preparation of a master’s thesis, or (2) a program involving only course work. Both programs require a minimum of 27 units, of which up to six units may be for the master’s thesis. Course work for the master’s degree may be taken on a part-time basis, but thesis research can be undertaken only by full-time graduate students. Thus, only the master’s degree without thesis can be earned entirely on a part-time basis.

The Science and Technology Entrepreneurship Program (STEP) is a three- or four-semester professional MS degree offered in chemistry as well as in biotechnology and physics. Students enter the Chemistry Entrepreneurship program with a bachelor’s, master’s, or doctoral degree in a chemistry-related field. The program consists of advanced courses in chemistry, business, and technology innovation and an entrepreneurial project with technical content in an existing company or new venture.

Doctor of Philosophy Program

The PhD degree in chemistry is granted to those students who have shown an extensive knowledge of advanced chemistry and the ability to do original research. The program usually requires four years of full-time study after the bachelor’s degree. Besides advanced courses, the program consists of cumulative and oral examinations, seminars and colloquia, and an original research project. At least twelve months must be spent in residence on campus while fulfilling the PhD thesis research requirement.

Full-time graduate students who maintain satisfactory academic performance while pursuing the PhD degree in chemistry normally receive a stipend for teaching and/or research, which includes full tuition and a monthly amount sufficient to cover living expenses.

Research

The Department of Chemistry is noted for research programs in (1) chemical biology and (2) energy and materials. Projects range from synthetic studies of important bioactive substances, including antibiotics and DNA-binding substances, to detailed examination of the surface
properties of materials used in batteries and electrolytic cells. Studies are being performed with molecules as simple as oxygen and as complicated as those which describe the active centers of enzymes or the protein core of insoluble aggregates that deposit in neurodegenerative disease. Efforts are being made to understand the basic chemical properties leading to reactive mediators generated from physiological lipids.

Other research is aimed at developing new drugs for photodynamic therapy and at understanding the mechanism of action of drugs for antiretroviral therapy. The influence of metal ions in modifying reactivity is a common interest of several members of the faculty, as is the development of organometallic compounds for materials and catalysis. Chemical surfaces are being studied, as are various applications of nanoparticles, from cells to the environment. Studies designed to characterize electrode-electrolyte interfaces, the electrochemical properties of new semiconductors, and single-cell microelectrodes are also ongoing. These efforts are complemented by theoretical studies on the interfacial structure and bonding of composite materials.

Case Western Reserve University ranks among the leading universities internationally in its strengths in electrochemistry and has brought these strengths together in the Yeager Center for Electrochemical Studies (YCES) (http://chemistry.case.edu/department/research/yces). The interdisciplinary nature of electrochemistry involves the interaction of electrochemists in the chemistry and chemical engineering departments with metallurgists, surface physicists, inorganic and organic chemists, polymer membrane chemists, and electrical engineers. Such interactions, lacking on most campuses, are promoted at Case Western Reserve University through YCES. Graduate students in the chemistry department have the opportunity to specialize in electrochemistry in one of the most extensive course and research programs in the United States.

Colloquia and Seminars

The department sponsors a rich program of colloquia and seminars on recent advances in chemical research. Most notable among these is the Frontiers in Chemistry Lecture Series, in which scientists of international distinction lecture on major discoveries and developments in chemistry. In addition, a weekly colloquium series provides lectures by invited speakers in a variety of fields of chemical investigation. Both of these programs are addressed to an audience of faculty, graduate students, and other chemical scientists in the university and the Cleveland area, and are a vital means to broaden current knowledge. Numerous other seminars and meetings are held on a more specialized and informal level. Most individual research groups conduct weekly discussions to evaluate their progress.

Primary Faculty

John D. Protasiewicz, PhD
(Cornell University)
Professor; Chair

Mary D. Barkley, PhD
(University of California, San Diego)
Distinguished University Professor and M. Roger Clapp University Professor of Arts and Sciences
Analytical Chemistry, Biochemistry, Biophysical Chemistry, Medicinal Chemistry, Photochemistry, Physical Chemistry, Theoretical Chemistry

Clemens Burda, PhD
(University of Basel, Switzerland)
Chemical Professor
Photochemistry, Materials, Physical Chemistry, Nanochemistry, Bio- and Energy Applications, Biophysical and Biomedical Science and Engineering, Spectroscopy

Carlos E. Crespo-Hernández, PhD
(University of Puerto Rico)
Associate Professor

Thomas G. Gray, PhD
(Harvard University)
Associate Professor
Organometallic Chemistry, Inorganic Chemistry, Energy

Irene Lee, PhD
(Pennsylvania State University)
Professor
Biochemistry, Medicinal Chemistry, Bio-Organic Chemistry

Drew A. Meyer, PhD
(Stanford University)
John Teagle Professorial Fellow in Chemistry, Instructor
Physical Chemistry, Inorganic Chemistry, X-Ray Spectroscopy, Chemical Education

Anthony J. Pearson, PhD
(University of Aston, Birmingham, England)
Rudolph and Susan Rense Professor of Chemistry
Organic Chemistry, Organometallic Chemistry, Catalysis, Natural Products, Synthesis

Emily Pentzer, PhD
(Northwestern University)
Frank Hovorka Assistant Professor in Chemistry
Organic Chemistry, Materials & Energy, Polymers, Nanostructures, Self-Assembly, Composites

Robert G. Salomon, PhD
(University of Wisconsin, Madison)
Charles Frederic Mabery Professor of Research in Chemistry
Biochemistry, Chemical Biology, Medicinal Chemistry, Organic Chemistry, Bio-Organic Chemistry, Cellular Biology, Molecular Biology, Natural Products, Pharmacology, Synthesis

Anna C. Samia, PhD
(Georgia Institute of Technology)
Associate Professor
Geneviève Sauvé, PhD  
(California Institute of Technology)  
Associate Professor  

Daniel A. Scherson, PhD  
(University of California, Davis)  
Frank Hovorka Professor of Chemistry  
Analytical Chemistry, Materials, Physical Chemistry, Photochemistry, Electrochemistry  

Rekha R. Srinivasan, PhD  
(Case Western Reserve University)  
James Stephen Swinehart, PhD, Professorial Teaching Fellow in Chemistry; Senior Instructor  
Analytical Chemistry, Biophysical Chemistry, Organic Chemistry, Chemical Education  

Gregory P. Tochtrop, PhD  
(Washington University Medical School)  
Professor  

Blanton S. Tolbert, PhD  
(University of Rochester)  
Associate Professor  
Biochemistry, Biophysical Chemistry, Structural Biology  

Rajesh Viswanathan, PhD  
(University of Indiana)  
Assistant Professor  
Organic Chemistry, Protein Biochemistry, Chemical Biology, Chemical Synthesis and Characterization, Genetically-Encoded Natural Products, Molecular Biology, Microbial Genetics, Bioinformatics, Metabolic Pathways, Drug Discovery  

Michael G. Zagorski, PhD  
(Case Western Reserve University)  
Professor  

Research Faculty  
Mikhail D. Linetsky, PhD  
(Academy of Science of Ukraine)  
Research Associate Professor  
Biochemistry, Chemical Biology, Protein Chemistry, Post-Translational Protein Modification, Proteomics  

Secondary Faculty  
Rigoberto Advincula, PhD  
(University of the Philippines)  
Professor  
Macromolecular Science & Engineering  

Paul Carey, PhD  
(University of Sussex, UK)  
Professor, Department of Biochemistry  
Biochemistry, Biophysical Chemistry, Microscopy / Imaging, Spectroscopy  

John W. Crabb, PhD  
(University of Kansas Medical Center)  
Professor, Department of Cell Biology, Lerner Research Institute, Cleveland Clinic  
Proteomics of the visual cycle and age-related ocular diseases  

Chris Dealwis, PhD  
Associate Professor, Department of Pharmacology  
Biochemistry, Biophysics, Enzyme Catalysis, Pharmacology, Proteins  

Thomas Gerken, PhD  
(Case Western Reserve University)  
Professor, Division of Pediatric Pulmonology  
Biochemistry, Biophysical Chemistry, Chemical Biology, Glycosylation, Protein Chemistry, Protein Structure  

Michael Harris, PhD  
(University of Alabama at Birmingham)  
Associate Professor  
Biochemistry  

Thomas Kelley, PhD  
(University of Notre Dame)  
Associate Professor, Division of Pediatric Pulmonology  
Biochemistry, Medicinal Chemistry, Cellular Biology, Pharmacology  

David Schiraldi, PhD  
(University of Oregon)  
Professor, Department of Macromolecular Science & Engineering  
Polymer synthesis and structure-property relationships, Condensation polymers, Polymer nanocomposites, Fuel cell durability, Polymerization catalysis, Transport phenomena and packaging applications, Polymer blends and complex polymer systems.  

Witold K. Surewicz, PhD  
(University of Lodz, Poland)  
Professor, Department of Physiology and Biophysics  
Biochemistry, Biophysical chemistry, Neurochemistry, Spectroscopy  

Lecturers  
Kenneth V. Adair, PhD  
(U(University of Oregon))  
Full-time Lecturer  
Water Quality Analysis, Fluorescence Correlation Spectroscopy, Chemical Dynamics  

Raul E. Juarez Hernandez, PhD  
(University of Notre Dame)  
Full-time Lecturer  
Organic Chemistry, Chemical Education
Adjunct Faculty

Ormond Brathwaite, PhD
(City University of New York)
Adjunct Associate Professor
Biochemistry

James Burgess, PhD
(Longwood College)
Adjunct Professor
Bio-Inorganic Chemistry, Electrochemistry

Michael J. Kenney, PhD
(Iowa State University)
Adjunct Associate Professor
Analytical Chemistry, Physical Chemistry, Chemical Education, Computer Programming, Application Development

M. Cather Simpson, PhD
(University of New Mexico)
Adjunct Associate Professor
Biophysical chemistry; spectroscopic studies of biologically significant processes

Emeritus Faculty

Robert C. Dunbar, PhD
(Stanford University)
Professor Emeritus of Chemistry

Gheorghe D. Mateescu, PhD
(Case Western Reserve University)
Professor Emeritus of Chemistry
Analytical Chemistry, Physical Chemistry

Barry Miller, PhD
(Massachusetts Institute of Technology)
Frank Hovorka Professor Emeritus of Chemistry
Physical Chemistry, Electrochemistry

Terry Swift, PhD
Professor Emeritus of Chemistry
Analytical Chemistry

Fred L. Urbach, PhD
(Michigan State University)
Professor Emeritus of Chemistry
Analytical Chemistry, Biochemistry, Inorganic Chemistry, Bio-Inorganic Chemistry, Catalysis

Courses

CHEM 105. Principles of Chemistry I. 3 Units.
Atomic structure; thermochemistry; periodicity, bonding and molecular structure; intermolecular forces; properties of solids; liquids, gases and solutions. Recommended preparation: One year of high school chemistry.

CHEM 106. Principles of Chemistry II. 3 Units.
Thermodynamics, chemical equilibrium; acid/base chemistry; oxidation and reduction; kinetics; spectroscopy; introduction to nuclear, organic, inorganic, and polymer chemistry. Prereq: CHEM 105 or CHEM 111.

CHEM 111. Principles of Chemistry for Engineers. 4 Units.
A first course in university chemistry emphasizing chemistry of materials for engineering students. Atomic theory and quantitative relationships; gas laws and kinetic theory; solutions, acid-base properties and pH; thermodynamics and equilibrium; kinetics, catalysis, and mechanisms; molecular structure and bonding. Recommended preparation: One year of high school chemistry.

CHEM 113. Principles of Chemistry Laboratory. 2 Units.
A one semester laboratory based on quantitative chemical measurements. Experiments include analysis, synthesis and characterization, thermochemistry and chemical kinetics. Computer analysis of data is a key part of all experiments. Prereq or Coreq: CHEM 105 or CHEM 106 or CHEM 111 or ENGR 145.

CHEM 114. Chemistry Frontiers Laboratory. 2 Units.
An introduction to laboratory techniques and computer-based methods for chemical research for the chemistry major. Scientific information databases, structural chemistry, experimental design and data handling, chemical synthesis and characterization. Prereq: CHEM 105 or CHEM 106, and CHEM 113. Coreq: CHEM 106.

CHEM 119. Concepts for a Molecular View of Biology I. 3 Units.
The first semester of a two-course sequence in elementary inorganic, organic, and biochemistry, intended for nursing students or non-majors. Topics include: atomic theory, the periodic table, chemical bonds, molecular geometry, ideal gas laws, equilibrium and reaction rates, acids and bases, nuclear chemistry, and nomenclature and reactions of organic compounds (including alkyl, aryl, alcohol, carbonyl, and amino compounds). Problems involving numeric computation are emphasized. This course is not open to students with credit for CHEM 105 or CHEM 111.

CHEM 121. Concepts for a Molecular View of Biology II. 3 Units.
The second course of a two-semester sequence in elementary inorganic, organic, and biochemistry, intended for nursing students or non-majors. Topics include: carbohydrate, lipids, proteins, enzyme kinetics, metabolic pathways and bioenergetics, DNA and RNA, methods of molecular biology, and nutrition. Applications to human physiology and medicine emphasized. This course is not open to students with credit for CHEM 223 or CHEM 323. Prereq: CHEM 119.

CHEM 223. Introductory Organic Chemistry I. 3 Units.
Introductory course for science majors and engineering students. Develops themes of structure and bonding along with elementary reaction mechanisms. Includes treatment of hydrocarbons, alkyl halides, alcohols, and ethers as well as an introduction to spectroscopy. Prereq: CHEM 106 or ENGR 145.
CHEM 224. Introductory Organic Chemistry II. 3 Units.
Continues and extends themes of structure and bonding from CHEM 223 and continues spectroscopy and more complex reaction mechanisms. Includes treatment of aromatic rings, carbonyl compounds, amines, and selected special topics. Prereq: CHEM 223 or CHEM 323.

CHEM 233. Introductory Organic Chemistry Laboratory II. 2 Units.
An introductory organic laboratory course emphasizing microscale operations. Synthesis and purification of organic compounds, isolation of natural products, and systematic identification of organic compounds by physical and chemical methods. Prereq: (CHEM 106 or ENGR 145) and CHEM 113. Prereq or Coreq: CHEM 223 or CHEM 323.

CHEM 234. Introductory Organic Chemistry Laboratory II. 2 Units.
A continuation of CHEM 233, involving multi-step organic synthesis, peptide synthesis, product purification and analysis using sophisticated analytical techniques such as chromatography and magnetic resonance spectroscopy. Prereq: CHEM 233. Prereq or Coreq: CHEM 224

CHEM 290. Chemical Laboratory Methods for Engineers. 3 Units.
Techniques of chemical synthesis, analysis, and characterization. Uses students' backgrounds in general and organic chemistry, but requires no background in chemical laboratory operations. Prereq or Coreq: CHEM 223 or CHEM 323.

CHEM 301. Introductory Physical Chemistry I. 3 Units.
First of a two-semester sequence covering principles and applications of physical chemistry, intended for chemistry and engineering majors and other students having primary interests in biochemical, biological or life-science areas. States and properties of matter. Thermodynamics and its application to chemical and biochemical systems. Chemical equilibrium. Electrochemistry. Recommended preparation: One year each of undergraduate physics and calculus, preferably including partial derivatives. Prereq: CHEM 106.

CHEM 302. Introductory Physical Chemistry II. 3 Units.

CHEM 304. Quantitative Analysis Laboratory. 2 Units.
A one-semester laboratory course providing practical experience in the analytical process. Focus is on statistical error analysis of measurements, method validation and instrument calibration, and reporting. Basic laboratory skills are developed and evaluated based on accuracy and precision of measurements. Experiments using titration, spectroscopy, electrochemistry, liquid and gas chromatography, and mass spectrometry are conducted. Prereq: CHEM 106 and CHEM 113. Coreq: CHEM 310.

CHEM 305. Introductory Physical Chemistry Laboratory. 3 Units.
A one-semester laboratory course focusing on the principles and quantitative characterization of chemical and biochemical systems. Experiments include chemical equilibrium kinetics, electrochemistry, spectroscopy and the use of computers for the statistical analysis of experimental data. Seminar discussions and disciplinary writing of results. Counts as SAGES Departmental Seminar. Prereq; CHEM 301 and CHEM 304 or CHEM 335. Or Prereq or Coreq: CHEM 302 or CHEM 336.

CHEM 306. Biochemistry Laboratory. 3 Units.
A one semester laboratory and lecture course developed to introduce students to a variety of chemical biology laboratory themes including buffering, identification of amino acids, immunoperoxidase, ligand binding, cellular fractionation, enzyme isolation and purification, proteomics, and enzyme kinetics. Techniques include titration, various forms of chromatography, colorimetric assays, electrophoresis, high performance liquid chromatography and liquid chromatography coupled with tandem mass spectrometry. Recommended preparation: CHEM 328/CHEM 428. Counts as SAGES Departmental Seminar. Prereq: CHEM 233.

CHEM 310. Foundations of Analytical Chemistry. 3 Units.
A one-semester lecture covering classical and modern aspects of the analytical process; analysis requirements, method selection including capabilities and limitations, sampling and sample processing, measurement data statistics for evaluation of precision and accuracy, method validation, and reporting. Fundamental concepts in equilibrium thermodynamics are covered in the context of chemical analysis. Methods based on titration, spectroscopy, electrochemistry, chromatography, and mass spectrometry are emphasized. Prereq: CHEM 106 and CHEM 113. Coreq: CHEM 304.

CHEM 311. Inorganic Chemistry I. 3 Units.
Fundamentals of inorganic chemistry. Topics include molecular structure, molecular shape and symmetry, structure of solids, d-metal complexes, oxidation and reduction, and acids and bases. Prereq or Coreq: CHEM 301 or CHEM 335.

CHEM 316. Frontiers of Inorganic Chemistry. 3 Units.
This course deals with five topics in inorganic chemistry of current interest. The topics are: ways in which inorganic chemistry can increase the quality of the environment, methods by which inorganic chemistry can lead to sustainable processes in a developed industrial society, advances in bioinorganic and medicinal inorganic chemistry of clinical importance, modern inorganic materials with unusual and valuable property sets, and representative industrial inorganic research and production processes. It is to be team taught. Offered as CHEM 316 and CHEM 416.

CHEM 322. Laboratory Methods in Organic Chemistry. 3 Units.
Experimental approach to the synthesis, purification and characterization of organic compounds. Nuclear magnetic resonance (NMR) and infrared (IR) spectroscopies; chromatographic techniques. Prereq: CHEM 304 and CHEM 223 or CHEM 323. Prereq or Coreq: CHEM 224 or CHEM 324.

CHEM 323. Organic Chemistry I. 3 Units.
Relationships between molecular structure and chemical reactivity and development of sophisticated problem-solving skills in the context of organic reaction mechanisms and multi-step synthesis. Homolytic and heterolytic substitution, elimination, oxidation and reduction reactions; topics in stereochemistry and spectroscopy. Recommended for chemistry, biochemistry, and related majors. Prereq: CHEM 106 or ENGR 145.

CHEM 324. Organic Chemistry II. 3 Units.
Continuation of CHEM 323. Introduces the chemistry of carbonyl, aromatic and amino functional groups, and develops the concepts of conjugation and resonance, molecular orbital theory and pericyclic reactions. Prereq: CHEM 223 or CHEM 323.

CHEM 325. Physical Methods for Determining Organic Structure. 3 Units.
Structure determination of organic compounds using mass spectrometry and modern instrumental techniques such as infrared, ultraviolet, visible, and nuclear magnetic resonance spectroscopy. Recommended preparation: Two semesters of undergraduate organic chemistry. Offered as CHEM 325 and CHEM 425.
CHEM 328. Introductory Biochemistry I. 3 Units.

CHEM 329. Biochemistry II: Living Systems. 3 Units.

CHEM 331. Laboratory Methods in Inorganic Chemistry. 3 Units.
Synthesis, separation techniques, physical properties, and analysis. Advanced techniques of chemical synthesis, leading the student to the preparation of interesting inorganic and organometallic compounds. Offered as CHEM 331 and CHEM 431. Prereq: CHEM 322.

CHEM 332. Laboratory Methods in Physical Chemistry. 3 Units.

CHEM 333. Medicinal Chemistry and Drug Development. 3 Units.
This course provides an overview on how principles in chemistry and biology are integrated to facilitate drug development. Primary emphasis will be placed on the development of organic molecules as drugs and metabolic enzymes as drug targets. Subjects pertinent to the introduction of medicinal chemistry, evaluation of drug efficacies in vitro and in vivo, and drug metabolism will be covered. Offered as CHEM 333 and CHEM 433. Prereq: CHEM 223 or CHEM 323 and BIOL 215. Coreq: CHEM 224 or CHEM 324.

CHEM 335. Physical Chemistry I. 3 Units.

CHEM 336. Physical Chemistry II. 3 Units.

CHEM 337. Quantum Mechanics I. 3 Units.
Introduction to quantization, measurement and the Schrodinger equation; angular momentum and states of molecules. Perturbation theory, spectroscopy and chemical bonding. Variational theory and calculations of molecular properties. Offered as CHEM 335 and CHEM 446. Prereq: CHEM 336.

CHEM 339. Bioinorganic Chemistry. 3 Units.
An introduction to metal ions in biology and medicine. Topics of emphasis include metalloenzymes, inorganic elements in pharmaceuticals, and physical methods of characterization in biology. Course material will be presented through a seminar format, and will involve extensive class participation, student presentations, and literature research reports. Offered as CHEM 339 and CHEM 439. Prereq: CHEM 224 or CHEM 324.

CHEM 340. Solar Energy Conversion. 3 Units.
This is a multidisciplinary course from a chemist’s point of view. This course teaches the background necessary to read and understand the scientific literature on solar energy conversion, and includes some basic device physics, materials chemistry and chemistry. Topics provide an overview of the field and includes: Global energy perspective, principles of photovoltaics, crystalline solar cells, thin-film solar cells, dye-sensitized solar cells, organic solar cells (with emphasis on polymer-based solar cells), photoelectrochemical cells and artificial photosynthesis for fuel production, and semiconductor nanostructures and quantum dots for solar energy conversion. The course includes three laboratories and a demo using state-of-the-art equipment, as well as presentations of recent research articles by the graduate students. It is recommended that students have experience with thermodynamics. The following CWRU courses would meet this expectation: CHEM 301, CHEM 335, ENGR 225 or PHYS 313. Offered as CHEM 340 and CHEM 440. Prereq: CHEM 106 or ENGR 145.

CHEM 341. Functional Nanomaterials. 3 Units.
This course is designed to introduce important concepts on the fundamental physical and chemical properties of technologically important nanometer scale materials. The course will cover an overview of the scientific principles pertaining to new properties at the nanoscale; synthesis and characterization tools; and existing and emerging applications of nanomaterials. It will center on current research developments on major classes of functional nanomaterials, including plasmonic nanoparticles, quantum dots, nanomagnets, carbon nanotubes, nanocatalysts and hybrid inorganic/organic nanostructures. In addition an emphasis will be placed on understanding the broader societal, economical and environmental impact of the scientific and technological advances brought forward by nanotechnology. Offered as CHEM 341 and CHEM 441.

CHEM 342. Computational Chemistry. 3 Units.
An introduction to computational methods in electronic structure. Molecular mechanics, semiempirical molecular orbital calculations, ab initio, post Hartree-Fock, density-functional theories, and hybrid approaches will be addressed. Continuum solvation calculations will be considered, time permitting. Offered as CHEM 342 and CHEM 442. Prereq: CHEM 223 or CHEM 323.
CHEM 344. The Chemistry and Physics of Energy Storage. 3 Units.
This course will cover both scientific and economic aspects of the operation of energy storage devices currently being considered for both small and large scale applications ranging from portable electronics to the electrical grid. These devices include pumped hydro, flywheel, compressed air, batteries, supercapacitors, thermal conversion, regenerative fuel cells and redox flow cells. Not to be included in this course are energy conversion devices such as photovoltaics and windmills. This course would be of interest to both undergraduate and graduate students with interest in the general area of energy management and will cover the physics and chemistry principles associated with the various modes of storage. Students either individually or in small groups will be expected to prepare a written document at the end of the course that describes and summarizes each mode of storage, including a discussion of all aspects of the technology such as costs of installation and operation, environmental impact, and economic projections. As part of this exercise students will become familiar with the extraordinary resources offered by our library. Offered as CHEM 344 and CHEM 444. Prereq: CHEM 106.

CHEM 395. Chemistry Colloquium Series. 1 Unit.
Course content provided by Thursday chemistry department colloquia (or Frontiers in Chemistry lectures). Discussion sessions review previous lectures and lay foundation for forthcoming lectures.

CHEM 397. Undergraduate Research. 1 - 6 Units.
Independent research project within a research group in the chemistry department or, by petition, within a research group in another Case department. Arrangements should be made with the faculty member selected. Open to all chemistry majors and other qualified students; required for Honors in Chemistry. A written report is required each semester.

CHEM 398. Undergraduate Research/Senior Capstone Project. 3 - 6 Units.
Independent research project within a research group in the chemistry department or, by petition, within a research group in another Case department. Arrangements should be made by consultation with the faculty member selected and the Senior Capstone Committee of the chemistry department. Open to all chemistry majors and other qualified students. Satisfies the research requirement for Honors in Chemistry. A written report and public oral presentations are required. Counts as SAGES Senior Capstone.

CHEM 406. Chemical Kinetics. 3 Units.
Theory and characterization of chemical rate processes. Recommended preparation: Two semesters of undergraduate physical chemistry.

CHEM 407. Chemical Thermodynamics. 3 Units.
Thermodynamics and statistical thermodynamics and their application to chemical problems. Recommended preparation: Two semesters of undergraduate physical chemistry.

CHEM 412. Advanced Inorganic Chemistry I. 3 Units.
Chemistry of inorganic systems. Spectroscopy, magnetism, and stereochemistry of transition metal compounds. Recommended preparation: One semester of undergraduate inorganic chemistry and two semesters of undergraduate physical chemistry.

CHEM 414. Organometallic Reactions and Structures. 3 Units.
Bonding, structure, and mechanistic aspects of organometallic chemistry and the relevance of organometallic species to chemical catalysis. Recommended preparation: One semester of undergraduate inorganic chemistry.

CHEM 416. Frontiers of Inorganic Chemistry. 3 Units.
This course deals with five topics in inorganic chemistry of current interest. The topics are: ways in which inorganic chemistry can increase the quality of the environment, methods by which inorganic chemistry can lead to sustainable processes in a developed industrial society, advances in bioinorganic and medicinal inorganic chemistry of clinical importance, modern inorganic materials with unusual and valuable property sets, and representative industrial inorganic research and production processes. It is to be team taught. Offered as CHEM 316 and CHEM 416.

CHEM 421. Advanced Organic Chemistry I. 3 Units.

CHEM 422. Advanced Organic Chemistry II. 3 Units.

CHEM 425. Physical Methods for Determining Organic Structure. 3 Units.
Structure determination of organic compounds using mass spectrometry and modern instrumental techniques such as infrared, ultraviolet, visible, and nuclear magnetic resonance spectroscopy. Recommended preparation: Two semesters of undergraduate organic chemistry. Offered as CHEM 325 and CHEM 425.

CHEM 428. Introductory Biochemistry I. 3 Units.

CHEM 429. Biochemistry II: Living Systems. 3 Units.

CHEM 430. Advanced Methods in Structural Biology. 1 - 6 Units.
The course is designed for graduate students who will be focusing on one or more methods of structural biology in their thesis project. This course is divided into 3-6 sections (depending on demand). The topics offered will include X-ray crystallography, nuclear magnetic resonance spectroscopy, optical spectroscopy, mass spectrometry, cryo-electron microscopy, and computational and design methods. Students can select one or more modules. Modules will be scheduled so that students can take all the offered modules in one semester. Each section is given in 5 weeks and is worth 1 credit. Each section covers one area of structural biology at an advanced level such that the student is prepared for graduate level research in that topic. Offered as BIOC 430, CHEM 430, PHOL 430, and PHRM 430.
CHEM 431. Laboratory Methods in Inorganic Chemistry. 3 Units.
Synthesis, separation techniques, physical properties, and analysis. Advanced techniques of chemical synthesis, leading the student to the preparation of interesting inorganic and organometallic compounds. Offered as: CHEM 331 and CHEM 431. Prereq: CHEM 322

CHEM 433. Medicinal Chemistry and Drug Development. 3 Units.
This course provides an overview on how principles in chemistry and biology are integrated to facilitate drug development. Primary emphasis will be placed on the development of organic molecules as drugs and metabolic enzymes as drug targets. Subjects pertinent to the introduction of medicinal chemistry, evaluation of drug efficacies in vitro and in vivo, and drug metabolism will be covered. Offered as CHEM 333 and CHEM 433.

CHEM 435. Synthetic Methods in Organic Chemistry. 3 Units.

CHEM 436. Complex Molecular Synthesis. 3 Units.
An advanced organic chemistry course providing students with an in-depth examination of the art of total synthesis drawing from both classical and recent examples. Recommended preparation: Two semesters of undergraduate organic chemistry.

CHEM 439. Bioinorganic Chemistry. 3 Units.
An introduction to metal ions in biology and medicine. Topics of emphasis include metalloenzymes, inorganic elements in pharmaceuticals, and physical methods of characterization in biology. Course material will be presented through a seminar format, and will involve extensive class participation, student presentations, and literature research reports. Offered as CHEM 339 and CHEM 439. Prereq: Graduate standing.

CHEM 440. Solar Energy Conversion. 3 Units.
This is a multidisciplinary course from a chemist's point of view. This course teaches the background necessary to read and understand the scientific literature on solar energy conversion, and includes some basic device physics, materials chemistry and chemistry. Topics provide an overview of the field and includes: Global energy perspective, principles of photovoltaics, crystalline solar cells, thin-film solar cells, dye-sensitized solar cells, organic solar cells (with emphasis on polymer-based solar cells), photoelectrochemical cells and artificial photosynthesis for fuel production, and semiconductor nanostructures and quantum dots for solar energy conversion. The course includes three laboratories and a demo using state-of-the-art equipment, as well as presentations of recent research articles by the graduate students. It is recommended that students have experience with thermodynamics. The following CWRU courses would meet this expectation: CHEM 301, CHEM 335, ENGR 225 or PHYS 313. Offered as CHEM 340 and CHEM 440.

CHEM 441. Functional Nanomaterials. 3 Units.
This course is designed to introduce important concepts on the fundamental physical and chemical properties of technologically important nanometer scale materials. The course will cover an overview of the scientific principles pertaining to new properties at the nanoscale; synthesis and characterization tools; and existing and emerging applications of nanomaterials. It will center on current research developments on major classes of functional nanomaterials, including plasmonic nanoparticles, quantum dots, nanomagnets, carbon nanotubes, nanocatalysts and hybrid inorganic/organic nanostructures. In addition an emphasis will be placed on understanding the broader societal, economical and environmental impact of the scientific and technological advances brought forward by nanotechnology. Offered as CHEM 341 and CHEM 441.

CHEM 442. Computational Chemistry. 3 Units.
An introduction to computational methods in electronic structure. Molecular mechanics, semiempirical molecular orbital calculations, ab initio, post Hartree-Fock, density-functional theories, and hybrid approaches will be addressed. Continuum solvation calculations will be considered, time permitting. Offered as CHEM 342 and CHEM 442. Prereq: CHEM 223 or CHEM 323.

CHEM 444. The Chemistry and Physics of Energy Storage. 3 Units.
This course will cover both scientific and economic aspects of the operation of energy storage devices currently being considered for both small and large scale applications ranging from portable electronics to the electrical grid. These devices include pumped hydro, flywheel, compressed air, batteries, supercapacitors, thermal conversion, regenerative fuel cells and redox flow cells. Not to be included in this course are energy conversion devices such as photovoltaics and windmills. This course would be of interest to both undergraduate and graduate students with interest in the general area of energy management and will cover the physics and chemistry principles associated with the various modes of storage. Students either individually or in small groups will be expected to prepare a written document at the end of the course that describes and summarizes each mode of storage, including a discussion of all aspects of the technology such as costs of installation and operation, environmental impact, and economic projections. As part of this exercise students will become familiar with the extraordinary resources offered by our library. Offered as CHEM 344 and CHEM 444. Prereq: CHEM 106.

CHEM 445. Electrochemistry I. 3 Units.
Electrochemical properties and processes of electrode/electrolyte interfaces. Fundamental background for work in corrosion, electrodeposition, industrial electrolysis, electro-organic synthesis, batteries, fuel cells, and photoelectrochemical energy conversion. Recommended preparation: One semester of undergraduate physical chemistry.

CHEM 446. Quantum Mechanics I. 3 Units.
Introduction of quantization, measurement and the Schrodinger equation; angular momentum and states of molecules. Perturbation theory, spectroscopy and chemical bonding. Variational theory and calculations of molecular properties. Recommended preparation: Two semesters of undergraduate physical chemistry. Offered as CHEM 335 and CHEM 446.

CHEM 450. Molecular Spectroscopy. 3 Units.
Translation, rotation, vibration, and electronic transitions of molecules. Prereq: CHEM 446.
CHEM 475. Protein Biophysics. 3 Units.
This course focuses on in-depth understanding of the molecular biophysics of proteins. Structural, thermodynamic and kinetic aspects of protein function and structure-function relationships will be considered at the advanced conceptual level. The application of these theoretical frameworks will be illustrated with examples from the literature and integration of biophysical knowledge with description at the cellular and systems level. The format consists of lectures, problem sets, and student presentations. A special emphasis will be placed on discussion of original publications. Offered as BIOL 475, CHEM 475, PHOL 475, PHRM 475, and NEUR 475.

CHEM 491. Modern Chemistry for Innovation I. 3 Units.
The first half of a two-semester sequence providing an understanding of chemistry as a basis for successfully launching new high-tech ventures. The course will examine physical limitations to present technologies and the use of chemistry to identify potential opportunities for new venture creation. The course will provide experience in using chemistry for both identification of incremental improvements and as the basis for alternative technologies. Case studies will be used to illustrate recent commercially successful (and unsuccessful) venture creation and will illustrate characteristics for success.

CHEM 493. Feasibility and Technology Analysis. 3 Units.
This course provides the tools scientists need to determine whether a technology is ready for commercialization. These tools include (but are not limited to): financial analysis, market analysis, industry analysis, technology analysis, intellectual property protection, the entrepreneurial process and culture, an introduction to entrepreneurial strategy and new venture financing. Deliverables will include a technology feasibility analysis on a possible application in the student’s scientific area. Offered as BIOL 493, CHEM 493, and PHYS 493.

CHEM 502. Special Topics in Inorganic Chemistry. 1 - 6 Units.
(Credit as arranged.) Lectures on advanced topics in inorganic chemistry presented by staff or visiting lecturers. Course title, content, and credit change from year to year.

CHEM 506. Special Topics in Physical Chemistry. 1 - 6 Units.
(Credit as arranged.) Lectures on advanced topics in physical chemistry presented by staff or visiting lecturers. Course title, content, and credit change from year to year.

CHEM 507. Special Readings in Chemistry. 1 - 6 Units.
Detailed study of a special topic in chemistry under the guidance of a faculty member.

CHEM 508. Special Readings in Chemistry. 1 - 6 Units.
Detailed study of a special topic in chemistry under the guidance of a faculty member.

CHEM 601. Research. 1 - 18 Units.
(Credit as arranged.) Special research in an area of chemistry under the guidance of a faculty member.

CHEM 605. Chemistry Colloquium Series. 0 Unit.
Course content provided by Thursday chemistry department colloquia (or Frontiers in Chemistry lectures). Discussion sessions review previous lectures and lay foundation for forthcoming lectures.

CHEM 651. Thesis M.S.. 1 - 18 Units.
(Credit as arranged.)

CHEM 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Childhood Studies Program

615 Crawford Hall
www.case.edu/artsci/childstudies
Phone: 216.368.0540
Jill Korbin, Elizabeth Short, Gabriella Celeste, Program Co-Directors

The Childhood Studies Program is an educational opportunity for undergraduate students interested in a wide array of issues concerning children and the experience of childhood. This interdisciplinary minor focuses on the life stages of infancy through adolescence and enables students to pursue interests in parenting, child development, gender, the life course, and the place of children in society and culture.

While the Childhood Studies Program is situated in the College of Arts and Sciences, children and childhood are a focus of research and teaching in units throughout the university, including the School of Medicine; the Jack, Joseph and Morton Mandel School of Applied Social Sciences; the School of Law; the School of Dental Medicine; and the Frances Payne Bolton School of Nursing.

The Childhood Studies Program is associated with the Schubert Center for Child Studies, which sponsors research, lectures, and programs on children and childhood and provides opportunities for student involvement in research, education, and policy, including externships with local nonprofits.

Undergraduate Program Minor

The undergraduate minor in childhood studies is built on a foundation in the social sciences. It is also suited, however, to students interested in exploring childhood from the perspectives of the natural sciences, the humanities, or the arts. The minor requires a minimum of 15 hours of course work; the courses must be taken in at least two different departments.

The courses listed below are accepted toward the minor. Other courses may be accepted with approval from one of the program co-directors.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>ANTH 306</td>
<td>The Anthropology of Childhood and the Family</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 399</td>
<td>Independent Study</td>
<td>1 - 6</td>
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<tr>
<td>CHST 301/ ANTH 305/ POSC 382A</td>
<td>Child Policy</td>
<td>3</td>
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<tr>
<td>CHST 302/ANTH 307</td>
<td>Experiential Learning in Child Policy</td>
<td>3</td>
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<tr>
<td>CHST 398/ANTH 308</td>
<td>Child Policy Externship</td>
<td>3</td>
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<tr>
<td>CHST/ANTH/PSCL 398C</td>
<td>Child Policy Externship and Capstone</td>
<td>3</td>
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<tr>
<td>CHST 399</td>
<td>Independent Study</td>
<td>1 - 6</td>
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<tr>
<td>COSI 313</td>
<td>Language Development</td>
<td>3</td>
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<tr>
<td>ENGL 369</td>
<td>Children's Literature</td>
<td>3</td>
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<tr>
<td>HSTY 387</td>
<td>Growing Up in America: 1607 - 2000</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 328</td>
<td>Child Nutrition, Development and Health</td>
<td>3</td>
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<tr>
<td>PSCL 230</td>
<td>Child Psychology</td>
<td>3</td>
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<tr>
<td>PSCL 329</td>
<td>Adolescence</td>
<td>3</td>
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<tr>
<td>PSCL 334C</td>
<td>Seminar and Practicum: Hospitalized Children</td>
<td>3</td>
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</tbody>
</table>
PSCL 335C  Seminar and Practicum:  Hospitalized Child  

PSCL 344  Developmental Psychopathology  
PSCL 379  Neurodevelopmental Disabilities  
PSCL 393  Experimental Child Psychology  
PSCL 397  Independent Study  
SASS 390  Independent Study for Undergraduates  
SOCI 320  Delinquency and Juvenile Justice  
SOCI 361  The Life Course  
SOCI 375  Independent Study  

**Independent studies or one-time course offerings approved by one of the program co-directors are also accepted toward the minor.**

* No more than four hours of practicum experience can count toward the minor.

**NOTE:** Students may count up to six of these hours toward a major in another field. If they are pursuing more than one major, they may count up to six hours toward each one.

**Co-Directors**

Jill E. Korbin, PhD  
Associate Dean, College of Arts and Sciences; Lucy Adams Leffingwell Professor, Department of Anthropology; Director, Schubert Center for Child Studies

Elizabeth Short, PhD  
Professor, Department of Psychological Sciences

Gabriella Celeste, JD  
Adjunct Instructor, Department of Anthropology; Director, Child Policy, Schubert Center for Child Studies

**Courses**

**CHST 301. Child Policy. 3 Units.**

This course introduces students to issues in public policy that impact children and families. Local, state, and federal child policy will be considered, and topics will include, for example, policies related to child poverty, education, child welfare, juvenile justice, and children's physical and mental health. Students will learn how policy is developed, how research informs policy and vice versa, and a framework for analyzing social policy. Recommended preparation: One social sciences course or consent. Offered as ANTH 305, CHST 301, and POSC 382A.

**CHST 302. Experiential Learning in Child Policy. 3 Units.**

Focus on state and federal legislative policy impacting children, youth, and families. Course includes an experiential learning component at the state or federal level and a travel experience to either Columbus, OH or Washington, DC to learn firsthand how policy is formed. Students may take this course twice for credit. Offered as ANTH 307 and CHST 302.

**CHST 398. Child Policy Externship. 3 Units.**

Externsions offered through CHST 398/ANTH 308 give students an opportunity to work directly with professionals who design and implement policies that impact the lives of children and their families. Agencies involved are active in areas such as public health, including behavioral health, education, juvenile justice, childcare and/or child welfare. Students apply for the externships, and selected students are placed in local public or nonprofit agencies with a policy focus. Each student develops an individualized learning plan in consultation with the Childhood Studies Program faculty and the supervisor in the agency. CHST 398/ANTH 308 is a 3 credit-hour course and may be taken twice for a total of 6 credit hours. Offered as CHST 398 and ANTH 308. Prereq: CHST 301.

**CHST 398C. Child Policy Externship and Capstone. 3 Units.**

Externsions offered through CHST/ANTH/PSCL 398C give students an opportunity to work directly with professionals who design and implement policies that impact the lives of children and their families. Agencies involved are active in areas such as public health, including behavioral health, education, juvenile justice, childcare and/or child welfare. Students apply for the externships, and selected students are placed in local public or nonprofit agencies with a policy focus. Each student develops an individualized learning plan in consultation with the Childhood Studies Program faculty and the supervisor in the agency. Offered as CHST 398C, ANTH 398C, and PSCL 398C. Counts as SAGES Senior Capstone. Prereq: CHST 301.

**CHST 399. Independent Study. 1 - 6 Units.**

Students propose topics for independent reading and research.

**Department of Classics**

Mather House  
http://classics.case.edu  
Phone: 216.368.2348; Fax: 216.368.4681  
Paul Iversen, Department Chair  
paul.iversen@case.edu

The Department of Classics introduces students to the culture, life, and legacy of ancient Greece and Rome through courses in the Greek and Latin languages and literatures, in ancient history, archaeology and medicine, in the visual and material cultures of the ancient Mediterranean world, and a focus on the classical tradition in Europe and beyond. The department faculty represents a range of academic disciplines and is committed, where appropriate, to an interdisciplinary approach in teaching and research.

The core purpose of the department is to offer the opportunity for study of the ancient classical languages, as a crucial point of entry into the conceptual worlds of Greece and Rome. Students are also exposed to the various facets of antiquity, particularly its mingling of cultures and belief systems, that made the ancient Mediterranean world the progenitor of the modern West. The different sub-disciplines and methodologies represented in the department involve multiple ways of exploring and understanding antiquity. Our students explore the philological, literary, historical, social, and philosophical dimensions of ancient texts, and they engage with material and visual culture and city form through archaeology, epigraphy, and art and architectural history. Further, they study major moments of the revival of antiquity and the various lenses through which subsequent eras understood or appropriated the past.

Knowledge of classical antiquity constitutes the backbone of a liberal education and is useful for further professional training in whatever field a student may ultimately pursue. It also provides an excellent basis for
informed engagement with the political, social, and cultural issues of our turbulent times, as well as for the appreciation and enjoyment of artistic and cultural achievement. A major or minor in Classics may be profitably combined with programs aimed toward law, medicine, management, diplomatic service, banking, journalism, library science, or politics; religious, philosophic, literary, or historical studies; careers in the fine arts (visual or performing); or museum and archival work.

Undergraduate Programs

Major

The core of the Classics major is the study of the languages and literatures of ancient Greece and Rome and the societies that spoke Greek and Latin until the end of the ancient world (usually taken as the 5th century of the Common Era). The major uniquely offers exposure to a range of approaches: literary, philological, historical, archaeological, art historical, philosophical, and anthropological. Further, the scope of the department has expanded to embrace the classical tradition in and even beyond Europe, with courses on literature and art and architecture up to the 20th century.

Concentrations

There are three separate tracks in the Classics major. Philology (Track A) is devoted to ancient languages and their associated literatures in the original languages (Greek, Latin, or Greek and Latin). Classical Civilization (Track B) focuses on ancient history, literature in translation, and archaeology. Classical Tradition (Track C) explores the legacy of antiquity from the European Middle Ages to the contemporary world. Please note that for Tracks B and C, students must complete study of either Greek or Latin to at least the intermediate level.

Each track requires 10 courses (30 hours), and at least two of these courses must be at the 300 level. For students who elect to complete their junior and senior year SAGES requirements in Classics, two additional courses (6 hours) are required, CLSC 320 Alexander the Great: Materials and Methods and CLSC 381 Classics Senior Capstone. (CLSC 320 may count as one of the Classics 300-level courses, provided the student takes his or her junior SAGES requirements outside of classics.)

In the Philology Concentration (Track A), students can earn one of three degrees: BA in Classics: Greek; BA in Classics: Latin; or BA in Classics: Greek and Latin. Students in Track A are required to take CLSC 231 Athens to Alexandria: The World of Ancient Greece and CLSC 232 Gods and Gladiators: The World of Ancient Rome, then any combination of eight GREK or LATN courses, at least two of which (6 hours) must be at the 300-level. To receive the BA in Classics: Greek and Latin, students must complete at least one year of their second language.

In the Classical Civilization Concentration (Track B), students are required to take CLSC 231 Athens to Alexandria: The World of Ancient Greece and CLSC 232 Gods and Gladiators: The World of Ancient Rome; at least one 200-level or higher GREK or LATN course (for most students, this will mean taking GREK or LATN 101, 102 and 201); and any combination of GREK, LATN, or CLSC courses to bring their course total to 10 (30 hours), at least two of which must be at the 300 level. The elective CLSC courses should consist of courses that focus on the period before the 6th century of the Common Era and not the Classical Tradition (Track C).

In the Classical Tradition Concentration (Track C), students are required to take and at least one course in Greek or Latin at the intermediate level or higher (students who enter the program without any Greek or Latin are required to take the introductory sequence in either language, which count toward the ten-course requirement) The department offers four 200-level courses in Classical Tradition, focusing respectively on the Renaissance and Baroque, the Enlightenment, Architecture and Urbanism from the Renaissance to the 20th Century, and Classics in Film (see list below). Students are required to take at least two of these courses.

- CLSC/WLIT 220 Art & Literature in the Classical Tradition, Pt 1: Renaissance and Baroque (14th to 17th centuries)
- CLSC/WLIT 222 Classical Tradition 2: Birth of Archaeology
- CLSC/ARTH 221 Building on Antiquity
- CLSC/WLIT 224 Sword and Sandal: The Classics in Film

Students must take at least one course at the 300 level from the following list:

- CLSC/ARTH 311 Rome: City and Image
- CLSC/WLIT 314 The Poetics of Eros: Love Poetry from Sappho to Shakespeare and Beyond
- CLSC 323/ WLT 423 Angels and Daimons: The Origins of Inspiration
- CLSC 324/ WLT 424 The Sublime and Grotesque in Literature
- CLSC 330 Topics in Classical Tradition
- CLSC/WLIT 331 Dante and the Classical Tradition: Middle Ages into Modernity
- CLSC/COGS 340 Seminar in Enlightenment Art and Literature: Piranesi and Vico

Keeping in mind that the student should have at least two 300-level courses out of ten, the remaining courses (two to four, depending on whether the student is required to take the beginning language sequence) may be chosen from the above lists or, subject to advisor’s approval, from the Classics, Greek, or Latin courses in general.

Study in Related Fields

Each student completing the Classics major is strongly advised to choose a related minor, selected in consultation with and approved by the departmental advisor, in such closely related fields as anthropology, art history, philosophy, comparative literature, history, theater, or English. The association between the department and the World Literature Program (p. 540) is especially close.

Departmental Honors

Departmental honors are given to students who earn the grade of A for their senior dissertation in CLSC 382 Senior Honors Thesis and maintain a GPA in the major of 3.5.

The Minor

A minor in Classics is designed to acquaint the student with aspects of the ancient civilizations of Greece and Rome by means of 15 hours of course work. These 15 hours may be any combination of Greek, Latin, and Classics courses, at least 3 hours of which must be at or above the 300 level. While the study of either Greek or Latin is encouraged, neither is required for the minor.
Graduate Study

Graduate Certificate Program/Post-Baccalaureate

The purpose of a graduate certificate program in Classics, known in our wider discipline as a post-baccalaureate certificate—or “post-bac” for short—is to prepare students who started “late” with Greek and Latin (i.e., after high school) for graduate work in Classics and related fields such as Philosophy, Art History and Medieval Studies. As a rule, such students need to solidify their language skills and gain experience in reading large quantities of Greek and/or Latin at an advanced speed. Students planning graduate study will have a way to prepare themselves without impossible pressures and time constraints. It takes many years of patient study to master Greek and Latin; one must devote hours to the project every single day. Few people are able to progress satisfactorily in ancient languages on their own, without instruction and without peers.

Our one-year program provides a bridge to full-fledged graduate study, although some individuals may choose to pursue our certificate simply as a means of enriching their lives.

We give post-bac students training in Greek and Latin, and the guidance they need to gain admittance into MA and PhD programs in Classics and other Humanities disciplines. Here at CWRU, our post-bac students regularly interact not only with our advanced undergraduate Classics majors but also with graduate students in History, English, and Art History, among other fields. This blending furnishes them with useful perspectives on the realities of doctoral studies in the humanities.

World Literature MA: Classics Track

Qualified students may pursue graduate work in Classics through the MA in the World Literature Program (p. 540) (WLIT). Classics courses at the 300 level may be taken for graduate credit in this way.

Department Faculty

Paul A. Iversen, PhD
(Ohio State University)
Associate Professor and Chair
Greek and Latin epigraphy; Hellenistic history and culture; Greek and Roman New Comedy

Florin Berindeanu, PhD
(University of Georgia)
Instructor; Director; World Literature Program; Secondary Appointment, Department of Cognitive Science
European literature; literary and semiotic theory; mysticism

Peter E. Knox, PhD
(Harvard University)
Eric and Jane Nord Family Professor at the Baker-Nord Center for the Humanities
Greek poetry of the Hellenistic period, Latin poetry, Roman culture, ancient epic and classical reception.

Rachel Hall Sternberg, PhD
(Bryn Mawr College)
Associate Professor
Greek language and literature; Greek social history; history of emotion; reception of the classical tradition in the age of Jefferson

Timothy R. Wutrich, PhD
(Tufts University)
Senior Instructor
Vergil; trojan-cycle plays of Euripides; Homeric hero in drama since antiquity

Secondary Faculty

Maggie L. Popma, PhD
(The Institute of Fine Arts, New York University)
Robson Junior Professor, Assistant Professor, Department of Art History and Art
Ancient Roman art and archaeology

Deepak Sarma, PhD
(University of Chicago)
Professor, Department of Religious Studies
Hinduism; Indian philosophy; method and theory in the study of religion

Visiting Faculty

Paul Hay, Classical Studies
Visiting Assistant Professor
"Saecularity" in post-Sullan Rome; Roman Literature

CLSC Courses

CLSC 102. Introduction to Byzantine History, 500-1500. 3 Units.
Development of the Byzantine empire from the emperor Constantine’s conversion to Christianity and founding of the eastern capital at Constantinople to the fall of Constantinople to Turkish forces in 1453. Offered as CLSC 102 and HSTY 102. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 193. The Ancient World. 3 Units.
Ancient Western history from the origins of civilization in Mesopotamia to the dissolution of the Roman Empire in the West. Offered as CLSC 193 and HSTY 193. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 199. Athens: In Search of Socrates. 3 Units.
Students selected for their strong background or interest in Greek Civilization spend Spring Break in Athens, Greece (thanks to a collaboration between CWRU’s Department of Classics and the Athens Centre). They follow an intensive seven-day itinerary of travel, visiting major monuments and museums including the Acropolis, Delphi, Epidaurus, and Aegina. Two class sessions of instruction in modern Greek help them to interact with people they meet; but the overwhelming emphasis lies on Classical Athens, the historical-cultural setting for the emergence of Western moral philosophy. The focus of this mini-course is on the figure of Socrates and the agenda of moral philosophy that the Athenian sage established. Readings from Plato, Aristophanes, and Aristotle. Via the Socratic method, students will also study Aristotle’s Ethics and test the applicability of that foundational text to their own lives. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 202. Classical Mythology. 3 Units.
CLSC 203. Gods and Heroes in Greek Literature. 3 Units.
This course examines major works of Greek literature and sets them in their historical and cultural context. Constant themes are war, wandering, tyranny, freedom, community, family, and the role of men and women within the household and the ancient city-state. Parallels with modern life and politics will be explored. Lectures and discussions. Offered as CLSC 203 and WLIT 203. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 204. Heroes and Hustlers in Roman Literature. 3 Units.
This course constitutes the second half of a sequence on Classical literature. Its main themes are heroism vs. self-promotion, love vs. lust, and the struggle between democracy and tyranny. These topics are traced in a variety of literary genres from the period of the Roman republic well into the empire. Parallels with modern life and politics will be drawn. Offered as CLSC 204 and WLIT 204. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 206. Ancient and Medieval Spain: Prehistory to 1492. 3 Units.
This course focuses on the history of the Iberian peninsula from before the Roman conquest from the Iberians, Greek, and Carthaginian settlements, through Roman, Visigothic, and Muslim rule to the conquest of Ferdinand and Isabella of the last non-Christian territory on the peninsula in 1492. The issues of conquest, frontier, cultural diversity, and change, tolerance, and intolerance will be examined. Offered as CLSC 206 and HSTY 206. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 220. Art & Literature in the Classical Tradition, Pt 1: Renaissance and Baroque (14th to 17th centuries). 3 Units.
Through lectures, varied assignments, and visits to the Cleveland Museum of Art this course will introduce students to the major issues in the study of early modern art and literatures. The emphasis will inevitably be on Italy, as the place where the physical remains of ancient Rome confronted and inspired such remarkable masters as Michelangelo (as poet and artist), Palladio, Gian Lorenzo Bernini, Nicholas Poussin (Bernini and Poussin are represented in the CMAI), though some artists -- notably Leonardo -- resisted the lure of the classical past. From Italy new ideas spread to the rest of Europe and beyond. We will not have much time to study Shakespeare in the course, but we will not be able to ignore the greatest author of the Renaissance period. Like Shakespeare, we will move between the court and the city, between scenes of often-enderaged order and scenes of sometimes-productive disorder, in which classical models provided a key cultural and even psychological resource in challenging times. Recommended preparation: CLSC 232. Offered as CLSC 220 and WLIT 220. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 221. Building on Antiquity. 3 Units.
Beginning with Ancient Greece and Rome and ending in Cleveland, the course will provide orientation in the architectural orders and in most periods of European and Euro-American architectural history, as well as, to an extent, architectural criticism. The issue of how architecture has meaning will be central, not least in connection with the formalized "language" of classicism and the emergence of development of building types (temple, museum, civic hall, transportation buildings, etc.). We will also review more subtle ways in which architecture conveys meaning or mood, and the assignment of gendered associations to certain architectural elements. The course will consider more or less blatant political uses of architecture and architectural imagery, but also more elusive and/or ambiguous cases, as well as the phenomenon of the shifting meanings of architecture through changes of era, owner, audience, etc. Offered as ARTH 221 and CLSC 221.

CLSC 222. Classical Tradition 2: Birth of Archaeology. 3 Units.
The course will focus on the history of diverse methods for studying societies remote in time and space; i.e., on the formation of the distinct disciplines of archaeology and anthropology, and the interest in the origins of human society and cultural practices. The birth of archaeology occurred in the context of the profound transformation of European cultural life in the eighteenth century, the era of the Enlightenment. On the basis of a range of cultural productions (literary and historical texts, objects of luxury and use, etc.), we will study visual and literary works and consider the relationship between different modes of artistic production and expression, as well as the marketing and display of prestigious objects, whether ancient or modern. We will consider the eighteenth-century model of experiential education, the "Grand Tour," and the formation of private and public collections, as well as the emergence of the museum as institution. Finally, we will also consider important recent work on the relationship between the production of luxury commodities (sugar, coffee, tea, etc.) through the plantation economy in the Americas and beyond and the development of attitudes and ideas in Europe. Offered as CLSC 222 and WLIT 222. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 224. Sword and Sandal: The Classics in Film. 3 Units.
Gladiator. Alexander. The 300. Contemporary society's continuing fascination with putting the ancient world on the big screen is undeniable; and yet the causes underlying this phenomenon are not quite so readily apparent. In this course we will watch and discuss a number of movies about the ancient world, running the gamut from Hollywood classics such as Ben-Hur and Spartacus to more recent treatments (the aforementioned 300 and Gladiator, for starters), and from the mainstream and conventional (Clash of the Titans, Disney's Hercules) to the far-out and avant-garde (Fellini's Satyricon, anyone?). As we do so we'll learn quite a bit about the art and economics of film, on one hand, and the ancient world, on the other. And yet what we'll keep coming back to are the big questions: what does our fascination with the ancient Mediterranean tell us about ourselves as a society? Why do such movies get made, and what kinds of agendas do they serve? To what extent can we recapture the past accurately? And if we can't, are we doomed to just endlessly projecting our own concerns and desires onto a screen, and dressing them in togas? No knowledge of ancient languages is required for this course. Offered as CLSC 224 and WLIT 224.

CLSC 226. Greek and Roman Sculpture. 3 Units.
This survey course explores the history of sculpture in ancient Greece and Rome, from the Mycenaean period through the reign of Constantine (A.D. 306-337). Students learn how to analyze works of sculpture in terms of form, function, and iconography. Particular emphasis is placed on situating sculptures within the changing historical, cultural, political, and religious contexts of the classical world, including the Greek city-state, the Hellenistic kingdoms that followed Alexander the Great, the Roman Republic, and the Roman Empire. Students will study a variety of sculptures--such as statues, reliefs, and carved gems—from across the Greek and Roman worlds. As we study sculptures from the classical world, we will consider questions of design, patronage, artistic agency, viewer reception, and cultural identity. We will also consider the cultural interaction between ancient Greece and Rome and what impact this had on the production and appearance of sculpture. Offered as ARTH 226 and CLSC 226. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 228. Ancient Greek Athletics. 3 Units.
Exploration of the role of athletics in the ancient, primarily Greek world, and their reflection in the art of the period. Offered as ARTH 228 and CLSC 228.
CLSC 230. Ancient Roman Art and Architecture. 3 Units.
This course surveys the history of Roman art and architecture from Rome's founding in 753 B.C. up through the reign of Constantine (A.D. 306-337). Students learn how to analyze works of art and architecture in terms of form, function, and iconography. Particular emphasis is placed on situating objects and monuments within the changing historical, cultural, political, and religious contexts of ancient Rome, including major changes such as the shift from the Roman Republic to the Roman Empire and the advent of Christianity. Students will study a variety of media--such as statues, painting, metalwork, and domestic and public architecture--from the city of Rome itself as well as Roman provinces as far afield as Asia Minor and North Africa. The course will introduce students to famous buildings such as the Colosseum and the Pantheon but also to lesser known but equally important works. As we study major objects and monuments from ancient Rome, we will consider questions of design, patronage, artistic agency, viewer reception, and cultural identity. We will also consider Rome's complex relationship to Greek culture and attempt to answer the question of what makes Roman art distinctly "Roman." Offered as ARTH 230 and CLSC 230. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 231. Athens to Alexandria: The World of Ancient Greece. 3 Units.
This course constitutes the first half of a year-long sequence on classical civilization. It examines the enduring significance of the Greeks studied through their history, literature, art, and philosophy. Lectures and discussion. (For the second course in the sequence, see CLSC 232 and HSTY 232.) Offered as CLSC 231 and HSTY 231. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 232. Gods and Gladiators: The World of Ancient Rome. 3 Units.
The enduring significance of the Romans studied through their history, literature, art, and philosophy. Lectures and discussion. Offered as CLSC 232 and HSTY 232. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 295. Medical Terminology. 3 Units.
A self-paced, computer-assisted course on the classical foundations (etymology) of modern English as well as the basic principles on which roots, prefixes, and suffixes combine to give precise meanings to composite words, which is then applied toward learning medical, biomedical and scientific terminology.

CLSC 301. Ancient Philosophy. 3 Units.
Western philosophy from the early Greeks to the Skeptics. Emphasis on the pre-Socratics, Plato and Aristotle. Recommended preparation: PHIL 101 and consent of department. Offered as CLSC 301 and PHIL 301.

CLSC 302. Ancient Greece: Archaic, Classical, and Hellenistic Periods. 3 Units.
The rise of Hellenic thought and institutions from the eighth to the third centuries B.C., the rise of the polis, the evolution of democracy at Athens, the crises of the Persian and Peloponnesian Wars, fifth-century historiography, the growth of individualism, and the revival of monarchy in the Hellenistic period. Offered as CLSC 302 and HSTY 302. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 304. Ancient Rome: Republic and Empire. 3 Units.
Growth and development of the Roman state from the unification of Italy in the early third century B.C. to the establishment of the oriental despotism under Diocletian and Constantine. The growth of empire in the Punic Wars, the uncertain steps toward an eastern hegemony, the crisis in the Republic from the Gracchi to Caesar, the new regime of Augustus, the transformation of the leadership class in the early Empire, and the increasing dominance of the military over the civil structure. Offered as CLSC 304 and HSTY 304. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 311. Rome: City and Image. 3 Units.
This course studies the architectural and urban history of Rome from the republican era of the ancient city up to the eighteenth century using the city itself as the major "text." The emphasis will be placed on the extraordinary transformations wrought in the city, or at least in key districts, by powerful rulers and/or elites, especially in the ancient empire and in the Renaissance and baroque eras. In a larger perspective, the great construction projects exerted a far-reaching effect within and beyond Europe, but we will study them in relation to their topographical situation, their functions, and their place in a long history of variations on prestigious themes since many of the artworks and the urban settings featured in the course carry the mark of the Long history of the city itself. Recommended preparation: At least one 200-level course in ANTH, ARTH, CLSC, ENGL, HSTY, or RLGN. Offered as ARTH 311, ARTH 411, and CLSC 311. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 312. Women in the Ancient World. 3 Units.
The course offers a chronological survey of women's lives in Greece, Hellenistic Egypt, and Rome. It focuses on primary sources as well as scholarly interpretations of the ancient record with a view to defining the construction of gender and sexuality according to the Greco-Roman model. Additionally, the course aims to demonstrate how various methodological approaches have yielded significant insights into our own perception of sex and gender. Specific topics include matriarchy and patriarchy; the antagonism between male and female in myth; the legal, social, economic, and political status of women; the ancient family; women's role in religion and cult; ancient theories of medicine regarding women; pederasty and homosexuality. Offered as CLSC 312 and WGST 312. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 314. The Poetics of Eros: Love Poetry from Sappho to Shakespeare and Beyond. 3 Units.
This course will explore the theme of love in all its multiplicity of meanings and changes over time from its first appearances in Near Eastern poetry (Song of Songs) and Greek lyric (the titular Sappho) through its various elaborations, Roman, Medieval, Renaissance, and Romantic. It will also address theoretical inquiries into the nature and purpose of erotic desire and its evaluation as an aesthetic phenomenon, including Freudian theory and modern contributions such as Roland Barthes and Georges Bataille. No knowledge of the original languages required. Offered as CLSC 314 and WLIT 314. Counts for CAS Global & Cultural Diversity Requirement.
CLSC 316. Greek Tragedy. 3 Units.
This course provides students the opportunity to read a significant number of ancient Greek tragedies in modern English translations. We shall read, study, and discuss selected works by Aeschylus, Sophocles, and Euripides, and attempt to understand the plays as literature composed for performance. We shall study literary elements within the plays and theatrical possibilities inherent in the texts. As we read the plays, we shall pay close attention to the historical context and look for what each play can tell us about myth, religion, and society in ancient Athens. Finally, we shall give occasional attention to the way these tragic dramas and the theater in which they were performed have continued to inspire literature and theater for thousands of years. Lectures will provide historical background on the playwrights, the plays, the mythic and historical background, and possible interpretation of the texts as literature and as performance pieces. Students will discuss in class the plays that they read. The course has three examinations and a final project that includes a short essay and a group presentation. Offered as CLSC 316, CLSC 416, WLIT 316, and WLIT 416. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 318. Archaeological & Epigraphical Field School. 3 Units.
This interdisciplinary course takes place in situ in the Mediterranean and will be attached to an active archaeological project. Students will learn the methodological principles of archaeological and epigraphical fieldwork by participating in activities such as surveying, excavation, museum work, geophysical survey, artifact analysis, and other scientific techniques. In addition to work in the field and museum, students will receive an introduction to the history Greco-Roman culture through visits to major archaeological sites in the region. Examples of active archaeological projects may vary, depending on the year. Offered as CLSC 318 and CLSC 418.

CLSC 320. Alexander the Great: Materials and Methods. 3 Units.
This course is the Classics Departmental Seminar in the SAGES sequence (normally taken in the Spring semester of a major’s Junior year), though it can also be taken for regular credit in Classics or History by both undergraduate and graduate students. The seminar offers students a firm grounding in the discipline of Classics with an emphasis on the diverse materials (particularly primary source material), methods and approaches that can be brought to bear on the study of Greco-Roman antiquity. Students will read and discuss the ancient sources and contemporary scholarship on the enigmatic Alexander the Great drawn from various fields of classics, including history, archaeology, art history, philosophy, gender studies, epigraphy, numismatics, and the reception of Alexander. Based upon this, they will then write a research paper that employs conventions found in the field of Classics. Much of this training, however, will also be transferable to other fields and periods. Because the scope of the seminar moves (along with Alexander himself) beyond Europe and examines the historical foundations of the antagonism between East and West, this course qualifies as a Global and Cultural Diversity course. Offered as CLSC 320, CLSC 420, HSTY 320 and HSTY 420. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 321. The Archaeology of Iron Age Italy and Sicily, ca. 1000-300 BCE. 3 Units.
This course traces the early history and archaeology of the Italian peninsula and Sicily from ca. 1000 BCE to 300 BCE. During this period, the movement of people brought with a transfer of people, ideas, and culture (both social and material) that would transform the population and landscape of ancient Italy and Sicily. We will look first at Southern Italy and Sicily, where, from about 750 BCE, Greek and Phoenician colonists settled. We will examine the characteristics of Greek and Phoenician colonies and monuments, as well as the characteristics of the interactions between the new arrivals and the indigenous population, especially the Sikels. We will then examine how the Villanovan culture was supplanted by the Etruscans in west-central Italy. Through the close examination of the material culture we will address topics such as status, urbanization, religion and ritual, and the cultures of Italy and Sicily within the wider Mediterranean world. Finally, we will look at another movement of people and politics: the expansion of Roman hegemony throughout the peninsula. Numerous theories attempt to explain the effect Roman occupation had on the other populations. We will analyze critically these theories and look for ourselves on the numerous ways indigenous populations could respond to “foreign” occupiers and how the occupiers responded to the indigenes. We will “read” material culture almost like text, guided by concepts such as “style,” “agency” and “habitus” among others. Through these lenses we will examine the archaeological material from multiple points of view (social, economic, religious, political). In turn, recent theoretical advances that seek to explain the processes of accommodation and emulation of, and resistance to, outside cultural influences will be looked at with a critical eye so that we can come away with fresh ideas about understanding what, and who, culture really is. Offered as CLSC 321 and HSTY 321. Counts for CAS Global & Cultural Diversity Requirement.
CLSC 322. Roman Drama and Theater. 3 Units.
This course is designed as a continuation of and companion to CLSC/ WLIT 316/416 Greek Tragedy in English Translation, although it may be taken without having taken, or before having taken, that course. Students in Roman Drama and Theater will read a significant number of ancient Roman plays in modern English translation and study non-literary theatrical entertainment of the Roman Republic and Empire, including mime and pantomime, gladiatorial shows, political speeches, courtroom drama, and various other spectacles. The dramatic texts that we shall study include the fragments of early Latin drama, selected comedies by Plautus and Terence, and the tragedies of Seneca, and the forensic speeches of statesman such as Cicero. We shall also consider Greek and Roman literature that comments on Roman theatrical practices. These works will be read for their literary merits and theatrical possibilities, while at the same time examining them for what they can tell us about Roma culture and society. Similarly, when studying the non-literary theatrical works we shall examine historical and theatrical context including archaeological evidence from theaters and amphitheaters and material remains (masks, depictions of actors and gladiators on vases, terra cotta lamps, mosaics, etc.). Finally, while the majority of the course focuses on drama originally written in Latin and theatrical entertainments performed in ancient Rome, the course will conclude with a survey of selected post-classical works indebted to the tradition of Roman drama and theater. Authors to be studied include Hrotsvitha, Marlowe, Shakespeare, Racine, Mollère, and the legacy of Roman drama and theater in contemporary stage and cinema such as Sondelms's A Funny Thing Happened on the Way to the Forum. Thus a secondary concern will be to consider how and in what ways the legacy of Roman drama and theater has continued to shape the dramatic arts since antiquity. Offered as CLSC 322, CLSC 422, WLIT 322, and WLIT 422. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 323. Angels and Daimons: The Origins of Inspiration. 3 Units.
The age old myth of the pact with the devil is central to some of the masterpieces of Western literature. Goethe's poem is focused on the battle between good and evil, angelic and demonic as archetypes of humanity. The confrontation between the two forces illustrates the perennial dichotomy of creation vs. destruction (apocalypse). They represent the origin of life and its continuation even when the angelic has been defeated. The course will contain philosophical and literary readings that treat the opposition, and sometimes simultaneity, of angelic and daimonic. Plato and the Neo-Platonic tradition will be explored in the course as well as various readings from Middle Ages up to 18th century that address the issue of inspiration through contamination with the mysterious forces of the invisible world. Offered as CLSC 323, CLSC 423, WLIT 323 and WLIT 423. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 324. The Sublime and Grotesque in Literature. 3 Units.
Early on in Western culture the question of sublime and grotesque was addressed by philosophers and writers. Aristotle and especially Longinus initiated the debate over what exactly made a work of art "sublim" or "Grotesque." This debate eventually in the 18th century gave birth to the discipline of aesthetics, which is one of the main foci of this course. To that end, in this course we will examine a few literary works in light of the most representative theories around the concept of sublime and grotesque: Aristotle, Longinus, Kant, Burke, Baumgartner, Nietzsche and Kierkegaard. Their theories will be applied to some of the most celebrated literary masterpieces written by Homer, Ovid, Dante, Cervantes and others. Offered as CLSC 324, CLSC 424, WLIT 324 and WLIT 424. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 325. Art at the Crossroads of Religion: Polytheistic, Christian, and Islamic Art in Antiquity. 3 Units.
People often single out the reign of Constantine (A.D. 306-337) as the point in history when Rome transformed from a polytheistic empire to a Christian empire. This course questions the strict divide between the categories of "pagan" and "Christian" in Rome in the imperial period and beyond. Through a close examination of the artistic and architectural record, students will come to understand that this dichotomy is a modern invention; for people living in the Roman Empire, religious identities were extraordinarily fluid. Indeed, traditional polytheistic religion and Christianity remained closely intertwined for centuries after Constantine "Christianized" the Empire. Moreover, religious pluralism had been a fundamental part of Roman culture since the founding of ancient Rome. We will survey a range of material culture, including public statuary, sarcophagi, silver hordes, and temples and churches. We will also examine sites such as the border city of Dura-Europos in Syria to explore how religious identities in the Roman Empire (including Judaism, early Christianity, and so-called mystery cults) interwove even when Rome was still supposedly a "pagan" Empire. The course pays particular attention to the art and architecture produced under Constantine, whom people today often remember as Rome's first Christian emperor but who represents, in fact, a complex amalgam of polytheistic and monotheistic practices and identities. We will also explore how Christian art slowly but ultimately became the predominant visual culture in the Roman Empire. Finally, we will examine how Early Islamic art and architecture exploited the Greco-Roman visual tradition to the ends of this new religion. Offered as ARTH 325, ARTH 425 and CLSC 325. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 326. Rome on Site: The Archaeology of the Eternal City. 3 Units.
This course offers the opportunity to examine firsthand Roman remains spanning 500 years of the city's history. For three weeks we will explore all sections of Rome and discover how different spheres of Roman life, such as religion, politics, leisure, and death, combined to shape one of the most renowned cityscapes of the ancient Mediterranean world. The course constitutes a mix of museum and site visits to expose us to the artifacts that help us interpret the Roman world, including art and other types of material culture, and the monumental architecture dominating much of Rome to this day. We will also explore important sites outside of the city, including Rome's remarkably well-preserved port at Ostia, the Emperor Hadrian's magnificent villa at Tivoli, and an optional visit to Pompeii and Herculanenum during an extended weekend. Some of the questions we will be asking when visiting the sites include: How did the expansion of the Roman Empire influence the stylistic repertories of the capital's artists and architects? How did the changing political environment shape the topography of the city from Republic to Empire? How can we read political messages and propaganda in the ancient structures? How did (and does) Rome live among, use, and reuse ancient remains? Students will be expected to be active participants in the daily tours. All students will be presenting on various structures as we come to them (topics to be assigned in advance of the trip). Graduate students are responsible for leading a day tour (with my assistance) - to create the itinerary and develop the thematic framework. Grades will be based on participation on site, presentations, and a paper. Offered as CLSC 326 and CLSC 426. Counts for CAS Global & Cultural Diversity Requirement.
CLSC 327. The Parthenon Then and Now: New Discoveries, Old Problems and Reception. 3 Units.
The Parthenon is an icon of western art and culture. Over 250 year of scholarship on this world-renowned building have revealed many of its secrets, but numerous questions still remain. New finds on the Acropolis itself and elsewhere in Greece have shed light on some of these issues, and as a result new theories abound. This seminar offers an overview of the temple, its architecture and sculpture, and will investigate its place in the civic and religious ideology of classical Athens. The course will also trace the Parthenon’s many post-classical permutations, into a Christian Church and an Islamic mosque, and its impact on later western art and architecture. Finally the class will debate the moral and ethical issue of the Elgin Marbles - to repatriate them to Greece or to retain them in the British Museum in perpetuity. Offered as ARTH 327, ARTH 427, CLSC 327, and CLSC 427. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 329. Marvels of Rome: Monuments and Their Decoration in the Roman Empire. 3 Units.
This course examines some of the most famous monuments of the Roman Empire, including Nero’s Golden House, the Colosseum, the Pantheon, Hadrian’s Villa at Tivoli, and the lavish villa of Piazza Ammerina in Sicily. We will study each monument in depth, delving into the architecture, paintings, sculptures, mosaics, and social functions of each monument. Students will learn how to analyze artistic and archaeological evidence, ancient textual evidence (poems, prose, and inscriptions), and secondary scholarship to reconstruct the visual appearances and historical and cultural contexts of the monuments in questions. Throughout the course, students will gain a new appreciation and deeper understanding of some of the most iconic buildings of the classical tradition. Offered as ARTH 329, ARTH 429, and CLSC 329. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 330. Topics in Classical Tradition. 3 Units.
This course will examine facets and tendencies of cultural development in modern Europe and beyond which involve the engagement of historians, philosophers, literary authors and critics, artists, architects, and/or society in general with the classical world and its legacy. In some cases courses will be programatically associated with special events, e.g., exhibitions in The Cleveland Museum of Art. No prerequisites have been included, but students taking this course should have completed intermediate humanities courses, preferably in CLSC/LATN/GREK as well as WLIT. Offered as CLSC 330 and CLSC 430.

CLSC 331. Dante and the Classical Tradition: Middle Ages into Modernity. 3 Units.
"Dante and the Classical Tradition" will introduce through the complex work of Dante the concept of classical tradition as an all-encompassing cultural term. Dante represents the grandiose example of the artist who seeks the complete synthesis between humanities and sciences and their incessant collaborative effort to broaden as much as possible the depths of human knowledge. Philosophy, Geography, Physics, Linguistics, Astronomy and Literature are steady landmarks in Dante’s work through which he aims to speak about the necessity of ever maintaining continuity between all domains of human knowledge. Dante’s work proposes high levels of excellence and while the course’s focus will be on his literary output the scientific interests and treatises he demonstrates will not be omitted during class discussion and bibliography included in the syllabus. Last but not least the focus will be on how we understand today the concept of classical tradition as a result of Dante’s writings. Offered as CLSC 331, CLSC 431, WLIT 331 and WLIT 431. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 332. Art and Archaeology of Ancient Italy. 3 Units.
The arts of the Italian peninsula from the 8th century B.C. to the 4th century A.D., with emphasis on recent archaeological discoveries. Lectures deal with architecture, sculpture, painting, and the decorative arts, supplemented by gallery tours at the Cleveland Museum of Art. Offered as ARTH 332, CLSC 332, and ARTH 432.

CLSC 333. Greek and Roman Painting. 3 Units.
Greek vase painting. Etruscan tomb painting and Roman wall painting. The development of monumental painting in antiquity. Offered as ARTH 333, CLSC 333, and ARTH 433.

CLSC 334. Art and Archaeology of Greece. 3 Units.
A survey of the art and architecture of Greece from the beginning of the Bronze Age (3000 B.C.) to the Roman conquest (100 B.C.) with emphasis on recent archaeological discoveries. Lectures deal with architecture, sculpture, painting, and the decorative arts, supplemented by gallery tours at the Cleveland Museum of Art. Offered as ARTH 334, CLSC 334, and ARTH 434.

CLSC 336. Representations of War in Ancient Rome. 3 Units.
Few societies in history have been as militaristic as ancient Rome--as proud of their warrior culture. This course examines the many ways that Romans constructed and contested their conceptions of war from the founding of the Roman Republic in 509 B.C.E. to the reign of Constantine (306-337 C.E.). Why did Romans choose to represent war in certain ways, and how did these artistic representations shape Romans’ military values? What can the visual record tell us about how different groups (soldiers, women, slaves) experienced war in the Roman world? We will explore major public monuments in the city of Rome (including triumphal arches and the Colosseum) and private objects (such as silver drinking vessels) to observe how Roman militarism pervaded different walks of life. We will also examine monuments on the edges of Rome’s empire, such as the towering trophies in modern France and Romania, to explore how works of art and architecture mediated the relationship between Romans and the peoples they conquered. Students will be encouraged to think about how art and architecture contributed to the construction of militarism as a chief Roman value, but also about how visual representations provided an important means to debate the value of Rome’s military efforts, to subvert Rome’s rigidly hierarchical social order, and to grapple with what it meant to “be Roman” as wars transformed Rome from a small city in Italy to a massive, pan-Mediterranean empire. After exploring Romans’ conceptions of war and victory, students also may ask whether the common comparison between the Roman Empire and modern America is appropriate. Offered as ARTH 336, ARTH 436 and CLSC 336. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 337. Ancient Medicine. 3 Units.
This course offers a general survey of the history of medicine from its origins in pre-historical times to Galen (2nd c. CE) with a view to gaining a better understanding of the path that eventually lead to modern medical practice. The various medical systems considered, including the ancient Babylonian, Egyptian, Jewish, Chinese, Ayurvedic, Greek and Roman traditions, will be examined through the study of primary and secondary sources, while key conceptual developments and practices are identified within their cultural and social context. Special issues, such as epidemics, women’s medicine, and surgery, are also explored and discussed. Offered as CLSC 337, CLSC 437, HSTY 337, and HSTY 437. Counts for CAS Global & Cultural Diversity Requirement.
CLSC 340. Seminar in Enlightenment Art and Literature: Piranesi and Vico. 3 Units.
This course explores aspects of the European eighteenth century as a transformative epoch in the history of western culture. Though the Enlightenment is usually associated especially with France, in this course we will focus on Italy, as the irresistible goal of travelers taking part in the "Grand Tour," and as a landscape of powerful ancient and modern architecture and artworks universally recognized as exemplary. In particular we will study one of the strangest and most fascinating visual artists of the period, the self-proclaimed architect Giovani Battista Piranesi (1720-1778) famous no less now than in his own time for his fantastic prison engravings as well as his views of Rome, involving a radical rethinking of the city as a particular kind of inhabited as well as imagined space. Piranesi's polemical response to the advocates of the Greek revival, then coming into fashion, will lead into discussion of the key philosophical debates and aesthetic shifts of the time, notably the emergence of the notion of the sublime as a category eventually subversive of western ideals of rationality and still present -- and potent -- in our own culture. Finally we will place Piranesi within a current of discussion of the origins and nature of language and of human society in general, not least as manifested in architecture and other symbolic practices. The leading figure here is the Neapolitan G.B. Vico, whose New Science of 1725 remains one of the most stimulating texts in the western intellectual tradition. Offered as CLSC 340, COGS 340, WLIT 340, CLSC 440, and WLIT 440.

CLSC 381. Classics Senior Capstone. 3 Units.
The capstone is the final requirement of the SAGES program and is normally taken in the fall semester of senior year. It involves an independent study paper resulting from exploration of a topic chosen in consultation with the student's capstone advisor, who will regularly review progress on the project. In the capstone students employ, integrate, and demonstrate analytical, rhetorical, and practical skills developed and honed through the SAGES curriculum as well as their major or minor studies. The Capstone Project has both a written and an oral component: oral presentation and argumentation will be stressed. The product of the capstone may take different forms: there will always be a written component, but other forms of expression are also encouraged, such as a webpage or poster for a poster session. As for the kind of project that might be done: students interested in literature might work on an annotated translation of a classical text; archaeology students might produce a virtual exhibit centered on a specific site or problem. Counts as SAGES Senior Capstone. Prereg: CLSC 231 and CLSC 232, plus courses prescribed for each track of the major.

CLSC 382. Senior Honors Thesis. 3 Units.
A course of independent study and research culminating in the preparation of a thesis on a topic approved by the supervising faculty member. Enrollment in this course must be approved by the Chair of the Department. Prereg: CLSC 381.

CLSC 395. Directed Readings. 1 - 3 Units.
Readings in English on a topic of interest to the student and acceptable to the instructor. Designed and completed under the supervision of the instructor with whom the student wishes to work.

CLSC 416. Greek Tragedy. 3 Units.
This course provides students the opportunity to read a significant number of ancient Greek tragedies in modern English translations. We shall read, study, and discuss selected works by Aeschylus, Sophocles, and Euripides, and attempt to understand the plays as literature composed for performance. We shall study literary elements within the plays and theatrical possibilities inherent in the texts. As we read the plays, we shall pay close attention to the historical context and look for what each play can tell us about myth, religion, and society in ancient Athens. Finally, we shall give occasional attention to the way these tragic dramas and the theater in which they were performed have continued to inspire literature and theater for thousands of years. Lectures will provide historical background on the playwrights, the plays, the mythic and historical background, and possible interpretation of the texts as literature and as performance pieces. Students will discuss in class the plays that they read. The course has three examinations and a final project that includes a short essay and a group presentation. Offered as CLSC 316, CLSC 416, WLIT 316, and WLIT 416. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 418. Archaeological & Epigraphical Field School. 3 Units.
This interdisciplinary course takes place in situ in the Mediterranean and will be attached to an active archaeological project. Students will learn the methodological principles of archaeological and epigraphical fieldwork by participating in activities such as surveying, excavation, museum work, geophysical survey, artifact analysis, and other scientific techniques. In addition to work in the field and museum, students will receive an introduction to the history Greco-Roman culture through visits to major archaeological sites in the region. Examples of active archaeological projects may vary, depending on the year. Offered as CLSC 318 and CLSC 418.

CLSC 420. Alexander the Great: Materials and Methods. 3 Units.
This course is the Classics Departmental Seminar in the SAGES sequence (normally taken in the Spring semester of a major's Junior year), though it can also be taken for regular credit in Classics or History by both undergraduate and graduate students. The seminar offers students a firm grounding in the discipline of Classics with an emphasis on the diverse materials (particularly primary source material), methods and approaches that can be brought to bear on the study of Greco-Roman antiquity. Students will read and discuss the ancient sources and contemporary scholarship on the enigmatic Alexander the Great drawn from various fields of classics, including history, archaeology, art history, philosophy, gender studies, epigraphy, numismatics, and the reception of Alexander. Based upon this, they will then write a research paper that employs conventions found in the field of Classics. Much of this training, however, will also be transferable to other fields and periods. Because the scope of the seminar moves (along with Alexander himself) beyond Europe and examines the historical foundations of the antagonism between East and West, this course qualifies as a Global and Cultural Diversity course. Offered as CLSC 320, CLSC 420, HSTY 320 and HSTY 420. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.
CLSC 422. Roman Drama and Theater. 3 Units.
This course is designed as a continuation of and companion to CLSC/WLIT 316/416 Greek Tragedy in English Translation, although it may be taken without having taken, or before having taken, that course. Students in Roman Drama and Theater will read a significant number of ancient Roman plays in modern English translation and study non-literary theatrical entertainment of the Roman Republic and Empire, including mime and pantomime, gladiatorial shows, political speeches, courtroom drama, and various other spectacles. The dramatic texts that we shall study include the fragments of early Latin drama, selected comedies by Plautus and Terence, and the tragedies of Seneca, and the forensic speeches of statesman such as Cicero. We shall also consider Greek and Roman literature that comments on Roman theatrical practices. These works will be read for their literary merits and theatrical possibilities, while at the same time examining them for what they can tell us about Roma culture and society. Similarly, when studying the non-literary theatrical works we shall examine historical and theatrical context including archaeological evidence from theaters and amphitheaters and material remains (masks, depictions of actors and gladiators on vases, terra cotta lamps, mosaics, etc.). Finally, while the majority of the course focuses on drama originally written in Latin and theatrical entertainments performed in ancient Rome, the course will conclude with a survey of selected post-classical works indebted to the tradition of Roman drama and theater. Authors to be studied include Hrotsvitha, Marlowe, Shakespeare, Racine, Mollère, and the legacy of Roman drama and theater in contemporary stage and cinema such as Sondheim’s A Funny Thing Happened on the Way to the Forum. Thus a secondary concern will be to consider how and in what ways the legacy of Roman drama and theater has continued to shape the dramatic arts since antiquity. Offered as CLSC 322, CLSC 422, WLIT 322, and WLIT 422. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 423. Angels and Daimons: The Origins of Inspiration. 3 Units.
The age old myth of the pact with the devil is central to some of the masterpieces of Western literature. Goethe’s poem is focused on the battle between good and evil, angelic and demonic as archetypes of humanity. The confrontation between the two forces illustrates the perennial dichotomy of creation vs. destruction (apocalypse). They represent the origin of life and its continuation even when the angelic has been defeated. The course will contain philosophical and literary readings that treat the opposition, and sometimes simultaneity, of angelic and daimonic. Plato and the Neo-Platonic tradition will be explored in the course as well as various readings from Middle Ages up to 18th century that address the issue of inspiration through contamination with the mysterious forces of the invisible world. Offered as CLSC 323, CLSC 423, WLIT 323 and WLIT 423. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 424. The Sublime and Grotesque in Literature. 3 Units.
Early on in Western culture the question of sublime and grotesque was addressed by philosophers and writers. Aristotle and especially Longinus initiated the debate over what exactly made a work of art “sublime” or “Grotesque.” This debate eventually in the 18th century gave birth to the discipline of aesthetics, which is one of the main foci of this course. To that end, in this course we will examine a few literary works in light of the most representative theories around the concept of sublime and grotesque: Aristotle, Longinus, Kant, Burke, Baumgartner, Nietzsche and Kierkegaard. Their theories will be applied to some of the most celebrated literary masterpieces written by Homer, Ovid, Dante, Cervantes and others. Offered as CLSC 324, CLSC 424, WLIT 324 and WLIT 424. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 426. Rome on Site: The Archaeology of the Eternal City. 3 Units.
This course offers the opportunity to examine firsthand Roman remains spanning 500 years of the city’s history. For three weeks we will explore all sections of Rome and discover how different spheres of Roman life, such as religion, politics, leisure, and death, combined to shape one of the most renowned cityscapes of the ancient Mediterranean world. The course constitutes a mix of museum and site visits to expose us to the artifacts that help us interpret the Roman world, including art and other types of material culture, and the monumental architecture dominating much of Rome to this day. We will also explore important sites outside of the city, including Rome’s remarkably well-preserved port at Ostia, the Emperor Hadrian’s magnificent villa at Tivoli, and an optional visit to Pompeii and Herculaneum during an extended weekend. Some of the questions we will be asking when visiting the sites include: How did the expansion of the Roman Empire influence the stylistic repertoires of the capital’s artists and architects? How did the changing political environment shape the topography of the city from Republic to Empire? How can we read political messages and propaganda in the ancient structures? How did (and does) Rome live among, use, and reuse ancient remains? Students will be expected to be active participants in the daily tours. All students will be presenting on various structures as we come to them (topics to be assigned in advance of the trip). Graduate students are responsible for leading a day tour (with my assistance) - to create the itinerary and develop the thematic framework. Grades will be based on participation on site, presentations, and a paper. Offered as CLSC 326 and CLSC 426. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 427. The Parthenon Then and Now: New Discoveries, Old Problems and Reception. 3 Units.
The Parthenon is an icon of western art and culture. Over 250 year of scholarship on this world-renowned building have revealed many of its secrets, but numerous questions still remain. New finds on the Acropolis itself and elsewhere in Greece have shed light on some of these issues, and as a result new theories abound. This seminar offers an overview of the temple, its architecture and sculpture, and will investigate its place in the civic and religious ideology of classical Athens. The course will also trace the Parthenon’s many post-classical permutations, into a Christian Church and an Islamic mosque, and its impact on later western art and architecture. Finally the class will debate the moral and ethical issue of the Elgin Marbles - to repatriate them to Greece or to retain them in the British Museum in perpetuity. Offered as ARTH 327, ARTH 427, CLSC 327, and CLSC 427. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 430. Topics in Classical Tradition. 3 Units.
This course will examine facets and tendencies of cultural development in modern Europe and beyond which involve the engagement of historians, philosophers, literary authors and critics, artists, architects, and/or society in general with the classical world and its legacy. In some cases courses will be programmatically associated with special events, e.g., exhibitions in The Cleveland Museum of Art. No prerequisites have been included, but students taking this course should have completed intermediate humanities courses, preferably in CLSC/LATN/GREK as well as WLIT. Offered as CLSC 330 and CLSC 430.
CLSC 431. Dante and the Classical Tradition: Middle Ages into Modernity. 3 Units.
"Dante and the Classical Tradition" will introduce through the complex work of Dante the concept of classical tradition as an all-encompassing cultural term. Dante represents the grandiose example of the artist who seeks the complete synthesis between humanities and sciences and their incessant collaborative effort to broaden as much as possible the depths of human knowledge. Philosophy, Geography, Physics, Linguistics, Astronomy and Literature are steady landmarks in Dante's work through which he aims to speak about the necessity of ever maintaining continuity between all domains of human knowledge. Dante's work proposes high levels of excellence and while the course's focus will be on his literary output the scientific interests and treatises he demonstrates will not be omitted during class discussion and bibliography included in the syllabus. Last but not least the focus will be on how we understand today the concept of classical tradition as a result of Dante's writings. Offered as CLSC 331, CLSC 431, WLIT 331 and WLIT 431. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 437. Ancient Medicine. 3 Units.
This course offers a general survey of the history of medicine from its origins in pre-historical times to Galen (2nd c. CE) with a view to gaining a better understanding of the path that eventually lead to modern medical practice. The various medical systems considered, including the ancient Babylonian, Egyptian, Jewish, Chinese, Ayurvedic, Greek and Roman traditions, will be examined through the study of primary and secondary sources, while key conceptual developments and practices are identified within their cultural and social context. Special issues, such as epidemics, women's medicine, and surgery, are also explored and discussed. Offered as CLSC 337, CLSC 437, HSTY 337, and HSTY 437. Counts for CAS Global & Cultural Diversity Requirement.

CLSC 440. Seminar in Enlightenment Art and Literature: Piranesi and Vico. 3 Units.
This course explores aspects of the European eighteenth century as a transformative epoch in the history of western culture. Though the Enlightenment is usually associated especially with France, in this course we will focus on Italy, as the irresistible goal of travelers taking part in the "Grand Tour," and as a landscape of powerful ancient and modern architecture and artworks universally recognized as exemplary. In particular we will study one of the strangest and most fascinating visual artists of the period, the self-proclaimed architect Giovanni Battista Piranesi (1720-1778) famous no less now than in his own time for his fantastic prison engravings as well as his views of Rome, involving a radical rethinking of the city as a particular kind of inhabited as well as imagined space. Piranesi's polemical response to the advocates of the Greek revival, then coming into fashion, will lead into discussion of the key philosophical debates and aesthetic shifts of the time, notably the emergence of the notion of the sublime as a category eventually subversive of western ideals of rationality and still present -- and potent -- in our own culture. Finally we will place Piranesi within a current of discussion of the origins and nature of language and of human society in general, not least as manifested in architecture and other symbolic practices. The leading figure here is the Neapolitan G.B. Vico, whose New Science of 1725 remains one of the most stimulating texts in the western intellectual tradition. Offered as CLSC 340, COGS 340, WLIT 340, CLSC 440, and WLIT 440.

CLSC 481. Special Studies. 1 - 6 Units.
Subject matter varies according to need.

CLSC 492. Graduate Certificate Thesis. 3 Units.
This course will be focused on the independent writing of a substantial term paper under the supervision of an advisor. It is required for the completion of the Graduate Certificate.

CLSC 493. Graduate Certificate Presentation. 1 Unit.
This course will involve the presentation of the term paper completed and refined during CLSC 492. Prereq: CLSC 492.

GREK Courses

GREK 101. Elementary Greek I. 3 Units.
Beginning course in Greek language, covering grammar (forms and syntax) and the reading of elementary selections from ancient sources. Makes a start toward reading Greek authors.

GREK 102. Elementary Greek II. 3 Units.
Beginning course in Greek language, covering grammar (forms and syntax) and the reading of elementary selections from ancient sources. Makes a start toward reading Greek authors. Prereq: GREK 101 or equivalent.

GREK 201. Greek Prose Authors. 3 Units.
Readings from authors such as Plato, Lysias, Xenophon, and Herodotus. Offered as GREK 201, GREK 401, WLIT 201 and WLIT 401.

GREK 202. Introduction to Greek Poetry. 3 Units.
Primarily readings from Homer, Hesiod, and Theocritus. Selections from Greek lyric may be introduced at the instructor's discretion. Offered as GREK 202, GREK 402, WLIT 202, and WLIT 402. Prereq: GREK 102 or equivalent.

GREK 305. Readings in Ancient Philosophy: Plato. 3 Units.
Reading and interpretation of selected dialogues by Plato and other philosophical works. Offered as GREK 305 and GREK 405. Prereq: GREK 202 or equivalent.

GREK 306. Tragedy. 3 Units.
Reading and interpretation of selected plays of Aeschylus, Euripides, and Sophocles. Offered as GREK 306, GREK 406, WLIT 306, and WLIT 406. Prereq: 200-level GREK or equivalent.

GREK 307. History. 3 Units.
Extensive reading in Thucydides' History of the Peloponnesian War, especially Books VI and VII, the expedition against Syracuse. Offered as GREK 307, GREK 407, WLIT 307 and WLIT 407. Prereq: GREK 202 or equivalent.

GREK 308. Comedy. 3 Units.
Origin, ambiance, and development of Greek Old Comedy and persisting characteristics of the genre. Translation of selected plays from Greek into English. Offered as GREK 308, GREK 408, WLIT 318, and WLIT 418. Prereq: 200-level GREK or equivalent.

GREK 311. Homer. 3 Units.
Reading and translation of extensive selections from the Odyssey. Introduction to epic meter, to Homeric Greek, and to the poet's style. Consideration of evidences of oral composition and discussion of the heroic tradition. Offered as GREK 311, GREK 411, WLIT 311 and WLIT 411. Prereq: 200-level GREK or equivalent.
GREK 370. Greek Prose Composition. 3 Units.
This course introduces students to the principles and practice of composing continuous passages of Greek prose. It is designed to review and to strengthen students' command of Attic forms while becoming more aware of the ways Greek syntax was employed to express thought. Via practice at writing Greek prose, the ultimate goal is for the students to become more proficient and sensitive readers of ancient Greek. Offered as GREK 370, GREK 470, WLIT 370 and WLIT 470. Prereq: 200-level GREK or equivalent.

GREK 380. Advanced Topics in Greek Literature. 3 Units.
Study and discussion of important authors, works, and topics not covered regularly. Content will reflect particular interests of students and faculty and timeliness of the topics. Offered as GREK 380 and GREK 480. Prereq: 200-level GREK or equivalent.

GREK 395. Directed Readings. 1 - 3 Units.
Readings in Greek of authors selected to serve the individual interests and needs of undergraduate students. Each program planned and completed under the supervision of the instructor with whom the student wishes to work. Offered as GREK 395 and GREK 495.

GREK 401. Greek Prose Authors. 3 Units.
Readings from authors such as Plato, Lysias, Xenophon, and Herodotus. Offered as GREK 201, GREK 401, WLIT 201 and WLIT 401.

GREK 402. Introduction to Greek Poetry. 3 Units.
Primarily readings from Homer, Hesiod, and Theocritus. Selections from Greek lyric may be introduced at the instructor's discretion. Offered as GREK 202, GREK 402, WLIT 202, and WLIT 402.

GREK 405. Readings in Ancient Philosophy: Plato. 3 Units.
Reading and interpretation of selected dialogues by Plato or other philosophical works. Offered as GREK 305 and GREK 405.

GREK 406. Tragedy. 3 Units.
Reading and interpretation of selected plays of Aeschylus, Euripides, and Sophocles. Offered as GREK 306, GREK 406, WLIT 306, and WLIT 406.

GREK 407. History. 3 Units.
Extensive reading in Thucydides' History of the Peloponnesian War, especially Books VI and VII, the expedition against Syracuse. Offered as GREK 307, GREK 407, WLIT 307 and WLIT 407.

GREK 408. Comedy. 3 Units.
Origin, ambiance, and development of Greek Old Comedy and persisting characteristics of the genre. Translation of selected plays from Greek into English. Offered as GREK 308, GREK 408, WLIT 318, and WLIT 418.

GREK 411. Homer. 3 Units.
Reading and translation of extensive selections from the Odyssey. Introduction to epic meter, to Homeric Greek, and to the poet's style. Consideration of evidences of oral composition and discussion of the heroic tradition. Offered as GREK 311, GREK 411, WLIT 311 and WLIT 411.

GREK 470. Greek Prose Composition. 3 Units.
This course introduces students to the principles and practice of composing continuous passages of Greek prose. It is designed to review and to strengthen students' command of Attic forms while becoming more aware of the ways Greek syntax was employed to express thought. Via practice at writing Greek prose, the ultimate goal is for the students to become more proficient and sensitive readers of ancient Greek. Offered as GREK 370, GREK 470, WLIT 370 and WLIT 470.

GREK 480. Advanced Topics in Greek Literature. 3 Units.
Study and discussion of important authors, works, and topics not covered regularly. Content will reflect particular interests of students and faculty and timeliness of the topics. Offered as GREK 380 and GREK 480.

GREK 495. Directed Readings. 1 - 3 Units.
Readings in Greek of authors selected to serve the individual interests and needs of undergraduate students. Each program planned and completed under the supervision of the instructor with whom the student wishes to work. Offered as GREK 395 and GREK 495.

LATN Courses
LATN 101. Elementary Latin I. 3 Units.
An introduction to the elements of Latin: pronunciation, forms, syntax, and reading.

LATN 102. Elementary Latin II. 3 Units.
An introduction to the elements of Latin: pronunciation, forms, syntax, vocabulary, and reading. Prereq: LATN 101 or equivalent.

LATN 201. Latin Prose Authors. 3 Units.
Reading and discussion of such prose authors as Cicero, Caesar, Livy or Pliny. Offered as LATN 201, LATN 401, WLIT 241 and WLIT 441. Prereq: LATN 102 or equivalent.

LATN 202. Vergil. 3 Units.
Primarily readings from The Aeneid; selections from Vergil's other work may be introduced at instructor's discretion. Recommended preparation: LATN 201 or equivalent. Offered as LATN 202, LATN 402, WLIT 232 and WLIT 432.

LATN 305. Literature of the Republic. 3 Units.
A reading course in prose and poetry of the Roman Republic. Extensive selections from Cicero and Catullus, and one comedy of Terence. Offered as LATN 305, LATN 405, WLIT 334, and WLIT 434. Prereq: 200-level LATN or equivalent.

LATN 307. Livy. 3 Units.
Readings in Books I and XXI, with other selections from this major Augustan historian. Offered as LATN 307, LATN 407, WLIT 347, and WLIT 447. Prereq: 200-level LATN or equivalent.

LATN 308. Horace: Odes and Epodes. 3 Units.
Readings and discussion of extensive selections from the poetry of Horace; consideration of Horace as exemplifying the spirit of the Augustan Age. Offered as LATN 308, LATN 408, WLIT 348, and WLIT 448. Prereq: 200-level LATN or equivalent.

LATN 351. Latin Didactic Literature. 3 Units.
Readings from didactic poetry such as Lucretius and Vergil's Georgics. Parodies like Ovid's Ars Amatoria or prose treatises may also be introduced. Offered as LATN 351, LATN 451, WLIT 451, and WLIT 451. Prereq: 200-level LATN or equivalent.

LATN 352. History. 3 Units.
Works of the Roman historian Cornelius Tacitus; his Annals I-VI dealing with his portrait of Emperor Tiberius and the Empire after the death of Augustus. Offered as LATN 352, LATN 452, WLIT 352, and WLIT 452. Prereq: 200-level LATN or equivalent.

LATN 354. Drama. 3 Units.
Reading of at least one play each by Plautus and Terence. Attention to the history of Latin and Greek New Comedy, and the contrasting styles of the two authors. Offered as LATN 354, LATN 454, WLIT 354, and WLIT 454. Prereq: 200-level LATN or equivalent.
LATN 356. Elegiac Poetry. 3 Units.
In this course we shall translate and interpret selected elegies by Catullus, Tibullus, Propertius, and Ovid. We will also devote considerable class time to the reading and in-depth analysis of the major secondary literature, starting with the introductory pieces in the newest companions published by Brill and Cambridge, and moving on to fundamental articles and perhaps even a full scholarly monograph. Offered as LATN 356, LATN 456, WLIT 336, and WLIT 436. Prereq: 200-level LATN or equivalent.

LATN 380. Advanced Topics in Latin Literature. 3 Units.
Study and discussion of important authors, works, and topics not covered regularly. Content will reflect particular interests of students and faculty and timeliness of topics. Offered as LATN 380 and LATN 480. Prereq: 200-level LATN or equivalent.

LATN 395. Directed Readings. 1 - 3 Units.
Directed readings in Latin of authors selected to serve the individual interests and needs of undergraduate students. Each program planned and completed under the supervision of the instructor with whom the student wishes to work. Offered as LATN 395 and LATN 495.

LATN 401. Latin Prose Authors. 3 Units.
Reading and discussion of such prose authors as Cicero, Caesar, Livy or Pliny. Offered as LATN 201, LATN 401, WLIT 241 and WLIT 441.

LATN 402. Vergil. 3 Units.
Primarily readings from The Aeneid; selections from Vergil's other work may be introduced at instructor's discretion. Recommended preparation: LATN 201 or equivalent. Offered as LATN 202, LATN 402, WLIT 232 and WLIT 432.

LATN 405. Literature of the Republic. 3 Units.
A reading course in prose and poetry of the Roman Republic. Extensive selections from Cicero and Catullus, and one comedy of Terence. Offered as LATN 305, LATN 405, WLIT 334, and WLIT 434.

LATN 407. Livy. 3 Units.
Readings in Books I and XXI, with other selections from this major Augustan historian. Offered as LATN 307, LATN 407, WLIT 347, and WLIT 447.

LATN 408. Horace: Odes and Epodes. 3 Units.
Readings and discussion of extensive selections from the poetry of Horace; consideration of Horace as exemplifying the spirit of the Augustan Age. Offered as LATN 308, LATN 408, WLIT 348, and WLIT 448.

LATN 451. Latin Didactic Literature. 3 Units.
Readings from didactic poetry such as Lucretius and Vergil's Georgics. Parodies like Ovid's Ars Amatoria or prose treatises may also be introduced. Offered as LATN 351, LATN 451, WLIT 351, and WLIT 451.

LATN 452. History. 3 Units.
Works of the Roman historian Cornelius Tacitus; his Annals I-VI dealing with his portrait of Emperor Tiberius and the Empire after the death of Augustus. Offered as LATN 352, LATN 452, WLIT 352, and WLIT 452.

LATN 454. Drama. 3 Units.
Reading of at least one play each by Plautus and Terence. Attention to the history of Latin and Greek New Comedy, and the contrasting styles of the two authors. Offered as LATN 354, LATN 454, WLIT 354, and WLIT 454.

LATN 456. Elegiac Poetry. 3 Units.
In this course we shall translate and interpret selected elegies by Catullus, Tibullus, Propertius, and Ovid. We will also devote considerable class time to the reading and in-depth analysis of the major secondary literature, starting with the introductory pieces in the newest companions published by Brill and Cambridge, and moving on to fundamental articles and perhaps even a full scholarly monograph. Offered as LATN 356, LATN 456, WLIT 336, and WLIT 436.

LATN 480. Advanced Topics in Latin Literature. 3 Units.
Study and discussion of important authors, works, and topics not covered regularly. Content will reflect particular interests of students and faculty and timeliness of topics. Offered as LATN 380 and LATN 480.

LATN 495. Directed Readings. 1 - 3 Units.
Directed readings in Latin of authors selected to serve the individual interests and needs of undergraduate students. Each program planned and completed under the supervision of the instructor with whom the student wishes to work. Offered as LATN 395 and LATN 495.

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Cognitive science is the scientific study of the mind in a transdisciplinary framework. The Department of Cognitive Science at Case Western Reserve University is specifically dedicated to the study of human higher cognition, including language, gesture, advanced social cognition, mathematical invention, scientific discovery, art, religion, music, literature, advanced tool use and advanced technology, theater and dance, fashions of dress, sign systems, creativity, and culture. The department draws on methods of research in the biological sciences, the social sciences, and the humanities. Its educational mission is to provide students with the best possible opportunity to integrate a wide variety of approaches and apply them to the study of human higher cognition.

The department provides basic training in core disciplines, as well as in a range of philosophical, evolutionary, linguistic, and computational issues bearing on cognitive science. It seeks to place cognitive science in a wider, more ecologically valid context than traditional programs in this field have typically allowed, so as to broaden our theories of those high-end cognitive capacities that mark human beings as distinctive.

The department offers an undergraduate major and minor in cognitive science and a master's degree in cognitive linguistics. By developing wide-ranging expertise in at least two or three relevant disciplines, our students can prepare for a variety of career options. Training in several disciplines will also provide increased choices for postgraduate study.

Undergraduate Programs
Major
In addition to meeting general education requirements, cognitive science majors must complete a minimum of 30 semester hours in cognitive science and approved related course work: 15 hours in the foundation component and 15 hours of elective course work. The foundation courses provide all students with a common basis for further study. They consist of:

COGS 101 Introduction to Cognitive Science 3
Department Faculty

William E. Deal, PhD
(Howard University)
Severance Professor in the History of Religion and Chair
Cognitive science of religion and ethics

Todd Oakley, PhD
(University of Maryland)
Professor
Cognitive linguistics; discourse analysis; attention

Fey Parrill, PhD
(University of Chicago)
Associate Professor
Language and co-speech gesture

Vera Tobin, PhD
(University of Maryland)
Assistant Professor
Cognitive linguistics, pragmatics, literature; evolution & development

Mark Turner, PhD
(University of California, Berkeley)
Institute Professor
Higher-order cognition and creativity; conceptual integration

Secondary Faculty

Florin Berindeanu, PhD
(University of Georgia)
Instructor, Department of Classics

Daniela Calvetti, PhD
(University of North Carolina, Chapel Hill)
James Wood Williamson Professor, Department of Mathematics, Applied Mathematics, and Statistics

Angela Ciccia, PhD
(Case Western Reserve University)
Assistant Professor, Department of Psychological Sciences

Fred Collopy, PhD
(Wharton School of the University of Pennsylvania)
Professor, Department of Information Systems, Weatherhead School of Management

Heath A. Demaree, PhD
(Virginia Institute of Technology)
Professor and Chair, Department of Psychological Sciences

Robert L. Greene, PhD
(Yale University)
Professor, Department of Psychological Sciences

Sandra Russ, PhD
(University of Pittsburgh)
Distinguished University Professor and Louis D. Beaumont University Professor, Department of Psychological Sciences

Peter Thomas, PhD
(University of Chicago)
Associate Professor, Department of Mathematics, Applied Mathematics, and Statistics

Graduate Program

MA in Cognitive Linguistics

“Cognitive linguistics goes beyond the visible structure of language and investigates the considerably more complex backstage operations of cognition that create grammar, conceptualization, discourse, and thought itself. The theoretical insights of cognitive linguistics are based on extensive empirical observation in multiple contexts, and on experimental work in psychology and neuroscience. Results of cognitive linguistics, especially from metaphor theory and conceptual integration theory, have been applied to wide ranges of nonlinguistic phenomena.”


Candidates may apply for admission to the degree program in cognitive linguistics with the purpose of pursuing the MA, or for non-degree status with the purpose of taking courses for credit that can be transferred to other institutions. The MA follows Plan A as described in the School of Graduate Studies (p. 1045) section of this bulletin. Accordingly, it requires 30 credit hours and a written MA thesis.
Adjunct Faculty

Per Aage Brandt, Doctorat d'Etat
(Sorbonne I, Paris)
Adjunct Professor, Retired

Yohannes Haile-Selassie, PhD
(University of California, Berkeley)
Adjunct Professor; Curator and Head of Physical Anthropology, Cleveland Museum of Natural History

Michael Householder, PhD
(University of California, Irvine)
Adjunct Associate Professor; Associate Director, SAGES

Bruce M. Latimer, PhD
(Kent State University)
Adjunct Professor, Cleveland Museum of Natural History

Courses

COGS 101. Introduction to Cognitive Science. 3 Units.
This course introduces students to the field of cognitive science. Cognitive scientists are interested in the nature of the human mind--basically, we ask how humans think. This is a huge question, and has been addressed in one way or another by pretty much every academic field. Cognitive science tries to unite work from many different fields, including computer science, neuroscience, psychology, linguistics, philosophy, music, art, and literary theory. In this course, you'll get a basic introduction to some of the topics that are central to human cognition, such as intelligence, categorization, language, and creativity. We'll ask what can be gained by taking an integrated, cognitive scientific approach to these topics.

COGS 102. Introduction to Cognitive Neuroscience. 3 Units.
A survey of the fundamental methods, findings, and theories that attempt to understand the human mind from a neuroscientific standpoint. The course provides the student with background knowledge of brain processes underlying such psychological phenomena as consciousness, sensation, perception, thought, language, and voluntary action. Since many fields of neuroscience have contributed to cognitive neuroscience, the approach of this course is cross-disciplinary. It introduces theories and data from clinical and experimental neuropsychology, brain imaging, neuroelectric and neuromagnetic brain activity, the neuroscience of language, and behavioral neuroscience, among other fields.

COGS 201. Human Cognition in Evolution and Development. 3 Units.
COGS 201 covers mind unfolding in time, including the fundamental methods, findings, and theories of human mental phylo- and ontogenesis. It provides the student with background knowledge about the unfolding of cognitive structures and functions over time, in both the deep temporal perspective of evolution (measured across many lifetimes) and the shorter one of development (measured within single lifetimes). The approach of the course is cross-disciplinary, including approaches that come from anthropology, archaeology, philosophy, computing science, comparative psychology, primatology, and comparative linguistics, among others.

COGS 202. Cognition and Culture. 3 Units.
This course studies the human mind in its natural environment: culture. It covers the fundamental methods, findings, and theories that attempt to understand the growth and evolution of cognition from either a social science or humanistic standpoint. It provides the student with background knowledge of theories of human cultural evolution and change, of the relationship between the cognizing individual and larger social-cognitive structures, and of such phenomena as distributed networks, cooperative mental work, and the phenomenology of human experience. Many disciplines have contributed to this knowledge; hence the approach of this course is cross-disciplinary, including ideas from cultural anthropology, literary studies, art and art history, musicology, philosophy, and the history of technology, among others.

COGS 205. Cognition and Design. 3 Units.
Urbanism is design; architecture is design; of course, the aesthetic shaping of artifacts (such as computers, cars, and coffee machines) is design. Configuring surfaces, volumes, and portions of space in special ways, creating and changing formats for things and places that allow cultural practices to unfold while delimiting them, are essential "designing" endeavors of human civilization and are, necessarily, activities based on the cognitive capacities and constraints of our species. We 'cognize' the human world in terms and frames of 'designed' surroundings. Design is a basic expressive activity, by which we interact with our artificial and natural surroundings and create 'interfaces' between mind and reality, thus upholding and interpretable world. Landscapes and cityscapes, work spaces of all sorts, buildings and parks, exteriors and interiors of homes, factories, institutions, and temples; furniture, artifacts such as machines, tools, weapons, symbolic objects, even the configuration ('building') of our own bodies, are design. An inquiry into cultural cognition, aiming to understand how humans as socio-cultural beings think and feel, therefore needs to explore this dimension of spatial expressivity and to acknowledge it as a constitutive fact of human meaning production; it needs to study the aesthetic and pragmatic, political and historical, philosophical and religious, and simply everyday practical, semiotic aspects of this basic form of human creativity. This course will focus on spatial expressivity--design--in several primary keys and scales, including design for learning; design for verbal and technical communication, interaction, and commerce; design for expressions of authority and deliberation; and design for emotional display.

COGS 206. Theory of Cognitive Linguistics I. 3 Units.
This is the first course in a two-course sequence presenting theory and practice of cognitive linguistics. Offered as COGS 206 and COGS 406.

COGS 215. Words and Mind. 3 Units.
There is something fascinating and special about words. They are the aspect of language that everyone knows about and pays attention to--and every academic discipline with an interest in language has something to say about them! The sheer number of words known by every speaker of any human language is quite vast (and the exact number is a mystery). In this class we will learn about words in all their aspects, and see what the wide weirdness of words can help us understand about the human mind. Subjects covered include the question of what makes a word (is "ouch" a word? "ain't?"); word origins; taboo words; words and memory; word boundaries; and word games, puns, and puzzles.
COGS 272. Morality and Mind. 3 Units.
Recent research in cognitive science challenges ethical perspectives founded on the assumption that rationality is key to moral knowledge or that morality is the product of divine revelation. Bedrock moral concepts like free will, rights, and moral agency also have been questioned. In light of such critiques, how can we best understand moral philosophy and religious ethics? Is ethics primarily informed by nature or by culture? Or is ethics informed by both? This course examines 1) ways in which cognitive science—and related fields such as evolutionary biology—impact traditional moral perspectives, and 2) how the study of moral philosophy and comparative ethics forces reconsideration of broad cognitive science theories about the nature of ethics. The course examines the concept of free will as a case study in applying these interpretive viewpoints. Interdisciplinary readings include literature from moral philosophy, religious ethics, cognitive science, and evolutionary biology. Offered as COGS 272 and RLGN 272.

COGS 301. Special Topics in Cognitive Science. 3 Units.
Special Topics in Cognitive Science. Topics vary. Permission of department is required. Offered as COGS 301 and COGS 401.

COGS 302. SAGES Departmental Seminar: Methods and Theories in Cognitive Science. 3 Units.
This course takes a look at the discipline of cognitive science by exploring the methods that cognitive scientists use in their research. We'll discuss how different methods reflect different approaches and traditions of thought and how they provide different answers to particular questions. We'll also discuss the process of translating research into writing and talk about how different kinds of writing reflect the many different methods used in cognitive science. Recommended preparation: COGS 101, COGS 102, COGS 201, and COGS 202. Counts as SAGES Departmental Seminar.

COGS 307. Cog Linguistics Theory II. 3 Units.
This is the second course in a two-course sequence presenting theory and practice of cognitive linguistics. Offered as COGS 307 and COGS 407. Counts as SAGES Departmental Seminar.

COGS 308. Advanced Research Workshop I. 3 Units.
This course is an advanced research workshop for undergraduates and MA students. The workshop involves development of research topics (theoretical or empirical), and working on them with the input of other workshop members to produce final papers. Offered as COGS 308 and COGS 408.

COGS 309. Advanced Research Workshop II. 3 Units.
This course is an advanced research workshop for undergraduates and MA students. The workshop involves development of research topics (theoretical or empirical), and working on them with the input of other workshop members to produce final papers. MA students in cognitive linguistics will typically take this course as the second part of a two-part sequence. Offered as COGS 309 and COGS 409.

COGS 310. Cognitive Science of Religion. 3 Units.
This course introduces theories and methods in the cognitive science of religion. Particular emphasis is placed on applying cognitive scientific concepts and theories to such religious issues as belief in deities, religious ritual, and morality. We examine such topics as the relationship of religious studies to evolution and cognition, cognitive theories or religious ritual, anthropomorphism and religious representation, religion as an evolutionary adaptation, and cognitive semantics and religious language. Course work includes student-led discussions, a research-intensive journal-length essay on a topic chosen in consultation with the Instructor, and presentation of research findings to the class. Course readings are taken from the humanities, the social sciences, and natural sciences. Offered as COGS 310, COGS 410, RLGN 310 and RLGN 410.

COGS 311. Mind and Media. 3 Units.
An introduction to the study of mind and media, including the study of multimodal communication. This course investigates patterns of human cognition that are ancient to human beings and upon which media have converged for powerful, immersive effect. The cognitive processes studied include perception, sensation, imagination, joint attention, narrative conception, simulation, dreaming, identity construction, imaginative play, and implicit learning. Students engage in hands-on media analysis to study how basic human mental operations are used in media to achieve a variety of effects. Students will be given access to a private website of instructions, readings, and materials for the course, and will be introduced to a range of vast, rich, searchable databases of media. Students will have ample opportunity to do research inside such databases. Offered as COGS 311 and COGS 411. Counts as SAGES Departmental Seminar.

COGS 312. Second Language Acquisition I. 3 Units.
This course is an introduction to the growing field of second language acquisition (SLA). SLA seeks to understand the linguistic, psychological and social processes that underlie the learning and use of second language(s). The goal of research is to identify the principles and processes that govern second language learning and use. SLA is approached from three perspectives in the course: 1) as linguistic knowledge; 2) as a cognitive skill; and 3) as a socially and personality-mediated process. Important factors in second language learning will be identified and discussed. These include: age-related differences, the influence of the first language, the role played by innate (universal) principles, the role of memory processes, attitudes, motivation, personality and cognitive styles, and formal versus naturalistic learning contexts. The objective of this course is to survey the principal research in second language acquisition. Students will become familiar with the major research issues through their reading of both primary and secondary sources, as well as through lectures and class discussions. Offered as COGS 312, COGS 412, LING 301 and LING 401.

COGS 313. Special Topics in Cognitive Linguistics. 3 Units.
This course covers special topics in the field of cognitive linguistics. Topics will vary from semester to semester. Offered as COGS 313 and COGS 413.
COGS 314. Second Language Acquisition II: Second Language Acquisition Research and Second Language Teaching. 3 Units.
This course will examine various issues in second language acquisition research that are particularly relevant to foreign language teaching and learning. Topics covered will include the role of input (listening/reading) vs. output (speaking/writing); implicit vs. explicit learning; negative vs. positive evidence (including the role of error correction); affective factors (motivation, anxiety); individual differences; teachability hypothesis and syllabus construction, program design/evaluation, language testing, among others. The purpose of this course is to survey the principal research in the acquisition of second language that is relevant to second language teaching in a classroom setting, and to obtain the state-of-the-art knowledge of the SLA research literature that is relevant to L2 teaching. The focus is not necessarily on the practical application of the SLA research, although we will not exclude discussion of classroom application. Rather, we critically examine and evaluate SLA research and come up with our own syntheses with respect to various issues. To achieve this goal, we should ask following questions in reading and discussing the relevant literature: 1) What are the main claims that the author(s) make(s)? 2) Are the author’s claims sound? If not why? 3) What further research is needed to answer remaining questions? Students will become familiar with the major research issues through their reading of both primary and secondary sources, as well as through lectures and class discussions. The students are required to complete a term project that addresses the issues treated in the course. Offered as LING 302, LING 402, COGS 314 and COGS 414. Prereq: COGS 301 or requisites not met permission.

COGS 316. Decision-Making. 3 Units.
This course is a topical introduction to decision-making, a major area of cognitive social science, with connections to economics, law, political science, business, policy, and related fields. Topics include game theory and rational calculation, equilibria, kinds of choice, heuristics, the role of affect in decision, framing, bounded rationality, mechanisms of choice such as heuristics, the role of social cognition in choice, concepts of self and other, and computer modeling of choice. The course also includes an introduction to the design of empirical behavioral research. Offered as COGS 316 and COGS 416. Counts as SAGES Departmental Seminar.

COGS 317. Cognitive Diversity. 3 Units.
This course surveys research from cognitive science (psychology, linguistics, neuroscience, etc.) on the ways that different people think differently. We will consider dimensions such as sex, gender, sexual orientation, race/ethnicity, bodily differences, cultural differences, and effects of speaking different languages. Students will choose the last two topics at the end of the semester (Different religions? Different ages? Whatever interests the class!). Offered as COGS 317 and COGS 417. Counts for CAS Global & Cultural Diversity Requirement.

COGS 319. Elements of Surprise. 3 Units.
This course will connect research into the cognitive experiences of surprise and suspense with the ways people can create those experiences for each other—cooperatively and uncooperatively—in everyday interaction and in cultural products like jokes, architecture, music, written narratives, films, and games. Topics include predictions and expectations involved in perceiving and navigating the physical world, cognitive biases, timing in conversation, language processing, attention, perspective-taking, counterfactual thinking, the psychological structure of explanations, and the psychology of "fair play." Offered as COGS 319 and COGS 419.
COGS 340. Seminar in Enlightenment Art and Literature: Piranesi and Vico. 3 Units.

This course explores aspects of the European eighteenth century as a transformative epoch in the history of western culture. Though the Enlightenment is usually associated especially with France, in this course we will focus on Italy, as the irresistible goal of travelers taking part in the "Grand Tour," and as a landscape of powerful ancient and modern architecture and artworks universally recognized as exemplary. In particular we will study one of the strangest and most fascinating visual artists of the period, the self-proclaimed architect Giovanni Battista Piranesi (1720-1778) famous no less now than in his own time for his fantastic prison engravings as well as his views of Rome, involving a radical rethinking of the city as a particular kind of inhabited as well as imagined space. Piranesi's polemical response to the advocates of the Greek revival, then coming into fashion, will lead into discussion of the key philosophical debates and aesthetic shifts of the time, notably the emergence of the notion of the sublime as a category eventually subsersive of western ideals of rationality and still present -- and potent -- in our own culture. Finally we will place Piranesi within a current of discussion of the origins and nature of language and of human society in general, not least as manifested in architecture and other symbolic practices. The leading figure here is the Neapolitan G.B. Vico, whose New Science of 1725 remains one of the most stimulating texts in the western intellectual tradition. Offered as CLSC 340, COGS 340, WLIT 340, CLSC 440, and WLIT 440.

COGS 352. Language, Cognition, and Religion. 3 Units.

This course utilizes theoretical approaches found in cognitive semantics--a branch of cognitive linguistics--to study the conceptual structures and meanings of religious language. Cognitive semantics, guided by the notion that conceptual structures are embodied, examines the relationship between conceptual systems and the construction of meaning. We consider such ideas as conceptual metaphor theory, conceptual blending, Image schemas, cross-domain mappings, metonymy, mental spaces, and idealized cognitive models. We apply these ideas to selected Christian, Buddhist, and Chinese religious texts in order to understand ways in which religious language categorizes and conceptualizes the world. We examine both the universality of cognitive linguistic processes and the culturally specific metaphors, conceptual blends, image schemas, and other cognitive operations that particular texts and traditions utilize. Offered as RLGN 352, RLGN 452, COGS 352 and COGS 452. Counts for CAS Global & Cultural Diversity Requirement.

COGS 365. Advanced Topics in Cognitive Neuroscience. 3 Units.

This course focuses on specific areas of research in cognitive neuroscience in some depth. The first half of the semester covers basics and fundamental research areas (e.g., perception, attention) and examines the (sometimes controversial) theoretical issue of what cognitive neuroscience techniques tell us about the mind. The second half of the semester is dedicated to examining selected research topics of interest to students. Students research and write 'grant proposals' for cognitive neuroscience experiments. The class culminates with students and invited faculty simulating a funding panel, and deciding which grants to 'fund' from a limited budget. Prereq: COGS 102.

COGS 378. Computational Neuroscience. 3 Units.

Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECS 478, MATH 478 and NEUR 478.

COGS 381. Philosophy and Cognitive Neuroscience. 3 Units.

This course will focus on the various methodologies used in the cognitive neurosciences, and explore their strengths and weaknesses from scientific and philosophical standpoints. We will begin by examining baseline measures (including IQ tests, tasks of cognitive flexibility, verbal and visual memory, causal/sequential thinking and narrative tasks) and their experimental design. Lesion methods will follow, with an eye toward understanding the strength of inferences that can be drawn from such data. The course will also focus on imaging techniques (CAT, PET, SPECT, fMRI, TMS, etc.) as well as measures of electrical activity such as EEG and single-cell recordings. Students will become familiar with many fundamental assumptions necessary for the implementation of each method, and philosophical questions associated with these endeavors and their potential impact on our knowledge and society. Recommend preparation: PHIL 101 or COGS 201. Offered as COGS 381 and PHIL 381.

COGS 390. Introduction to General Semiotics. 3 Units.

Semiotics, the study of meaning and signs conveying meaning, is a central part of cognitive semiotics, or 'high level' cognitive semantics. This discipline is typically taught in departments of linguistics, cognitive science, philosophy, or cultural studies. The domain of semiotics is in fact widely intersecting with other disciplines (general linguistics, philosophy, neuroscience, anthropology, music, literature, architecture, and the arts). Sign theory, text theory, studies of narrative structure, enunciation, natural logic, rhetoric and poetics, speech act forms, are important components in this field.

COGS 391. Introduction to Text Semiotics. 3 Units.

Introduction to Text Semiotics addresses both students of Literature and students in Cognitive Science. Most of the authors included in the reading list extend their linguistic approach towards fields that intersect literature, psychology, philosophy, aesthetics, and anthropology. The scholarly traditions of text analysis and structural theory of meaning, including authors from classical formalism, structuralism, structural semiotics, and new criticism will be connected to cognitive theories of meaning construction in test, discourse, and cultural expressions in general. The focus of this course, taught as a seminar, is on empirical studies, specific text analyses, discourse analyses, speech act analyses, and other studies of speech, writing, and uses of language in cultural contexts. This course thus introduces to a study of literature and cultural expressions based on cognitive science and modern semiotics—the new view that has been coined Cognitive Semiotics. Offered as COGS 391 and WLIT 391.

COGS 397. SAGES Capstone in Cognitive Science. 3 Units.

Supervised original research on a topic in cognitive science, culminating in a public presentation. The research may be in the form of an independent research project, a literature review, or some other form approved by the department. Counts as SAGES Senior Capstone.
This course is for students with special interests and commitments that are not fully addressed in regular courses, and who wish to work independently.

COGS 401. Special Topics in Cognitive Science. 3 Units.
Special Topics in Cognitive Science. Topics vary. Permission of department is required. Offered as COGS 301 and COGS 401.

COGS 402. Advanced Introduction to Cognitive Neuroscience. 3 Units.
This course takes an advanced look at how the methods of cognitive neuroscience can be used to inform theories of cognitive function, with implications for a range of disciplines. Students will be given an overview of methods, brain anatomy, and major findings in the field. In addition, they will read a number of primary source papers. The student may expect to come away from the course with a broad acquaintance with modern cognitive neuroscience, how its findings are relevant to a variety of fields, and how to critically assess primary source material. Cognitive neuroscience is a rapidly evolving field which synthesizes methodologies and conceptual frameworks from numerous different disciplines. No single individual can hope to master all the methods, background knowledge and conceptual systems which are of key importance to the discipline at any one point in time. Cognitive Neuroscience is, therefore, a group activity, in which progress is critically dependent on group interactions both at a local level (the ‘lab’) and at more distributed levels (the wider scientific/academic community). The key objectives of this introductory course are therefore: 1. To give students a basic overview of current methods in cognitive neuroscience and the current state of knowledge in the field. 2. To enable students to go to, read, understand, research and evaluate the primary literature (i.e. journal articles). 3. To train students in the skills involved in group work, in particular through division of work and integration of acquired knowledge at a local level (i.e. lab-sized group), through effective and clear presentation of work, and through productive interactions with a large community. The first objective will be accomplished through lectures and assigned textbook readings. The second goal will be accomplished through assigned journal article readings. The third goal will be accomplished through a group structured format for accomplishing work, and through ‘journal club’ style presentations to the class.

COGS 406. Theory of Cognitive Linguistics I. 3 Units.
This is the first course in a two-course sequence presenting theory and practice of cognitive linguistics. Offered as COGS 206 and COGS 406.

COGS 407. Cog Linguistics Theory II. 3 Units.
This is the second course in a two-course sequence presenting theory and practice of cognitive linguistics. Offered as COGS 307 and COGS 407. Counts as SAGES Departmental Seminar. Prereq: COGS 406 or consent of instructor.

COGS 408. Advanced Research Workshop I. 3 Units.
This course is an advanced research workshop for undergraduates and MA students. The workshop involves development of research topics (theoretical or empirical), and working on them with the input of other workshop members to produce final papers. Offered as COGS 308 and COGS 408.

COGS 409. Advanced Research Workshop II. 3 Units.
This course is an advanced research workshop for undergraduates and MA students. The workshop involves development of research topics (theoretical or empirical), and working on them with the input of other workshop members to produce final papers. MA students in cognitive linguistics will typically take this course as the second part of a two-part sequence. Offered as COGS 309 and COGS 409.

COGS 410. Cognitive Science of Religion. 3 Units.
This course introduces theories and methods in the cognitive science of religion. Particular emphasis is placed on applying cognitive scientific concepts and theories to such religious issues as belief in deities, religious ritual, and morality. We examine such topics as the relationship of religious studies to evolution and cognition, cognitive theories or religious ritual, anthropomorphism and religious representation, religion as an evolutionary adaptation, and cognitive semantics and religious language. Course work includes student-led discussions, a research-intensive journal-length essay on a topic chosen in consultation with the Instructor, and presentation of research findings to the class. Course readings are taken from the humanities, the social sciences, and natural sciences. Offered as COGS 310, COGS 410, RLGN 310 and RLGN 410.

COGS 411. Mind and Media. 3 Units.
An introduction to the study of mind and media, including the study of multimodal communication. This course investigates patterns of human cognition that are ancient to human beings and upon which media have converged for powerful, immersive effect. The cognitive processes studied include perception, sensation, imagination, joint attention, narrative conception, simulation, dreaming, identity construction, imaginative play, and implicit learning. Students engage in hands-on media analysis to study how basic human mental operations are used in media to achieve a variety of effects. Students will be given access to a private website of instructions, readings, and materials for the course, and will be introduced to a range of vast, rich, searchable databases of media. Students will have ample opportunity to do research inside such databases. Offered as COGS 311 and COGS 411. Counts as SAGES Departmental Seminar.

COGS 412. Second Language Acquisition I. 3 Units.
This course is an introduction to the growing field of second language acquisition (SLA). SLA seeks to understand the linguistic, psychological and social processes that underlie the learning and use of second language(s). The goal of research is to identify the principles and processes that govern second language learning and use. SLA is approached from three perspectives in the course: 1) as linguistic knowledge; 2) as a cognitive skill; and 3) as a socially and personality-mediated process. Important factors in second language learning will be identified and discussed. These include: age-related differences, the influence of the first language, the role played by innate (universal) principles, the role of memory processes, attitudes, motivation, personality and cognitive styles, and formal versus naturalistic learning contexts. The objective of this course is to survey the principal research in second language acquisition. Students will become familiar with the major research issues through their reading of both primary and secondary sources, as well as through lectures and class discussions. Offered as COGS 312, COGS 412, LING 301 and LING 401.

COGS 413. Special Topics in Cognitive Linguistics. 3 Units.
This course covers special topics in the field of cognitive linguistics. Topics will vary from semester to semester. Offered as COGS 313 and COGS 413.
COGS 414. Second Language Acquisition II: Second Language Acquisition Research and Second Language Teaching. 3 Units.
This course will examine various issues in second language acquisition research that are particularly relevant to foreign language teaching and learning. Topics covered will include: the role of input (listening/reading) vs. output (speaking/writing); implicit vs. explicit learning; negative vs. positive evidence (including the role of error correction); affective factors (motivation, anxiety); individual differences; teachability hypothesis and syllabus construction, program design/evaluation, language testing, among others. The purpose of this course is to survey the principal research in the acquisition of second language that is relevant to second language teaching in a classroom setting, and to obtain the state-of-the-art knowledge of the SLA research literature that is relevant to L2 teaching. The focus is not necessarily on the practical application of the SLA research, although we will not exclude discussion of classroom application. Rather, we critically examine and evaluate SLA research and come up with our own syntheses with respect to various issues. To achieve this goal, we should ask following questions in reading and discussing the relevant literature: 1) What are the main claims that the author(s) make(s)? 2) Are the author’s claims sound? If not why? 3) What further research is needed to answer remaining questions? Students will become familiar with the major research issues through their reading of both primary and secondary sources, as well as through lectures and class discussions. The students are required to complete a term project that addresses the issues treated in the course. Offered as LING 302, LING 402, COGS 314 and COGS 414. Prereq: COGS 401 or requisites not met permission.

COGS 416. Decision-Making. 3 Units.
This course is a topical introduction to decision-making, a major area of cognitive social science, with connections to economics, law, political science, business, policy, and related fields. Topics include game theory and rational calculation, equilibria, kinds of choice, heuristics, the role of affect in decision, framing, bounded rationality, mechanisms of choice such as heuristics, the role of social cognition in choice, concepts of self and other, and computer modeling of choice. The course also includes an introduction to the design of empirical behavioral research. Offered as COGS 316 and COGS 416. Counts as SAGES Departmental Seminar.

COGS 417. Cognitive Diversity. 3 Units.
This course surveys research from cognitive science (psychology, linguistics, neuroscience, etc.) on the ways that different people think differently. We will consider dimensions such as sex, gender, sexual orientation, race/ethnicity, bodily differences, cultural differences, and effects of speaking different languages. Students will choose the last two topics at the end of the semester (Different religions? Different ages? Whatever interests the class!). Offered as COGS 317 and COGS 417. Counts for CAS Global & Cultural Diversity Requirement.

COGS 419. Elements of Surprise. 3 Units.
This course will connect research into the cognitive experiences of surprise and suspense with the ways people can create those experiences for each other—cooperatively and uncooperatively—in everyday interaction and in cultural products like jokes, architecture, music, written narratives, films, and games. Topics include predictions and expectations involved in perceiving and navigating the physical world, cognitive biases, timing in conversation, language processing, attention, perspective-taking, counterfactual thinking, the psychological structure of explanations, and the psychology of “fair play.” Offered as COGS 319 and COGS 419.

COGS 427. Gesture in Cognition and Communication. 3 Units.
Most people never notice that when they are talking, they’re also gesturing. Why do we produce these gestures? What can studying them tell us about the human mind? This course surveys scientific research on gesture, exploring topics such as the role of gesture in communication, cross-cultural differences in gesture, and the relationship between gesture and signed languages. The course will focus on gestures produced with speech, but will cover symbolic and ritualized gesture in the visual arts and in dance. Offered as COGS 327, COGS 427 and MLIT 327. Counts as SAGES Departmental Seminar.

COGS 452. Language, Cognition, and Religion. 3 Units.
This course utilizes theoretical approaches found in cognitive semantics—a branch of cognitive linguistics—to study the conceptual structures and meanings of religious language. Cognitive semantics, guided by the notion that conceptual structures are embodied, examines the relationship between conceptual systems and the construction of meaning. We consider such ideas as conceptual metaphor theory, conceptual blending, Image schemas, cross-domain mappings, metonymy, mental spaces, and idealized cognitive models. We apply these ideas to selected Christian, Buddhist, and Chinese religious texts in order to understand ways in which religious language categorizes and conceptualizes the world. We examine both the universality of cognitive linguistic processes and the culturally specific metaphors, conceptual blends, image schemas, and other cognitive operations that particular texts and traditions utilize. Offered as RLGN 352, RLGN 452, COGS 352 and COGS 452. Counts for CAS Global & Cultural Diversity Requirement.
The Department of Psychological Sciences offers courses of study in communication sciences leading to Bachelor of Arts, Master of Arts, and Doctor of Philosophy degrees. The Communication Sciences Program prepares undergraduate and graduate students to address broad issues of human communication processes and disorders through the application of cutting-edge technology and rigorous clinical training. We provide a comprehensive foundation in normal and disordered human communication and combine it with innovative interdisciplinary experiences that capitalize on the extensive resources of the university and the surrounding medical community. The department enjoys a particularly close relationship with Cleveland Hearing & Speech Center (http://www.chsc.org), an outstanding independent, nonprofit provider of care in speech-language pathology and audiology; in fact, the program is housed within the center.

Many students pursue undergraduate study in communication disorders as preparation for further study in other fields or in conjunction with study in other fields. For example, one can combine a major in communication disorders with a major in sociology or psychology or with a minor in gerontological studies. Professionals in human services fields such as medicine, social work, nursing, or education often work with persons with communication disorders. For students interested in academic or research careers, investigation in the field of communication disorders is often done alongside investigation of normal human behavior. For example, one might study the word learning of children with normal language as well as that of children with language impairment.

**Psychology**

103 Mather Memorial Building
Phone: 216.368.2686

The Psychology Program offers the combined advantages of a strong liberal arts college and a major university. There are classes in all major areas of the psychology field. We encourage close student-faculty relationships and offer many opportunities for individualized study and research.

Psychology is the study of the mind and behavior. The discipline embraces all aspects of the human experience: from the functions of the brain to the actions of neurons, from child development to care for the aged. In settings ranging from scientific research centers to mental health care services, “the understanding of behavior” is the enterprise of psychologists. An undergraduate major in psychology offers a student preparation for a wide variety of careers. Many majors find psychology to be an excellent preparation for such service-oriented professions as social work, counseling and guidance, special education, and management. Those who pursue graduate work in one of the many fields of psychology often seek positions in teaching and research or applied human services. In addition, the study of psychology provides a knowledge and an understanding of behavior that has applications in professions such as nursing, medicine, law, teaching, business, and public relations.

**Communication Sciences**

**Major**

The major in communication sciences leads to the Bachelor of Arts degree. For many students, a BA in communication sciences is a pre-professional degree in preparation for graduate study in speech-language pathology or audiology. The undergraduate course work emphasizes the basic processes and acquisition of normal communication in children and adults. Graduate study then focuses on the study of disordered communication. (Please see the description of the Integrated Graduate Studies Program below.)

Students pursuing the BA are required to take 45 credit hours of course work which includes study in communication sciences and disorders, psychology, and English/linguistics, as well as in statistics and research design. A recommended course sequence is shown below. Please note, however, that an individual student’s sequence may differ from this one. For example, undergraduate students may elect to take 400- or 500-level graduate courses with departmental/instructor permission.

**Suggested Sequence of Required Courses for the Bachelor of Arts Degree (45 credits)**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Psychology I (PSCL 101)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Communication Disorders (COSI 109)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonetics and Phonology (COSI 211)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multicultural Aspects of Human Communication (COSI 260)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child Psychology (PSCL 230)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to American Sign Language I (COSI 220)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantitative Methods in Psychology (PSCL 282)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Linguistics (COSI 355)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>9</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Third Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language Development (COSI 313)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anatomy and Physiology of Speech and Hearing Mechanism (COSI 325)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Design and Analysis (PSCL 375)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speech and Hearing Science (COSI 321)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>9</td>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Clinical Practice in Speech-Language Pathology (COSI 352)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Audiology (COSI 370)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication and Aging (COSI 345)</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td></td>
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</tr>
</tbody>
</table>

Total Units in Sequence: 45

* COSI 109 Introduction to Communication Disorders is offered in the fall and spring semesters. All other COSI courses are offered only one semester per year, as indicated above.

**Departmental Honors**

Juniors with a 3.0 overall grade point average and a 3.25 average in communication sciences are encouraged to apply to the honors program.
The honors program consists of one three-credit course, COSI 395 Capstone and Honors Program, in which the student carries out an independent project in an area of interest, under the direction of a COSI faculty member. Satisfactory completion of the project qualifies the student to receive the Bachelor of Arts degree with departmental honors noted on the transcript. Admission to the honors program is by faculty approval.

The following are prerequisites to COSI 395 Capstone and Honors Program:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 201</td>
<td>Basic Statistics for Social and Life Sciences</td>
<td>3</td>
</tr>
<tr>
<td>or PSCL 282</td>
<td>Quantitative Methods in Psychology</td>
<td></td>
</tr>
<tr>
<td>PSCL 375</td>
<td>Research Design and Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional information is available from the academic advisor.

### Integrated Graduate Studies

The Integrated Graduate Studies (IGS) Program (p. 1078) is intended for undergraduate students who are interested in obtaining a graduate degree in communication disorders (speech-language pathology). Qualified students may be accepted for admission to the School of Graduate Studies after completing 90 hours of undergraduate course work.

Typically, a master’s degree requires two additional years of study beyond the bachelor’s degree. Through the IGS Program, however, a student can complete an undergraduate degree in communication disorders and a master’s degree in communication disorders in five years. The recommended undergraduate sequence for students interested in the IGS Program is somewhat different from the recommended sequence presented above. Students should consult their academic advisor and the Office of Undergraduate Studies for additional information concerning IGS requirements.

### Minor in Communication Sciences

The minor in communication sciences requires a minimum of 15 credit hours. It focuses on normal processes of speech, language, and hearing, as well as on the speech, language, and hearing disorders that result from breakdowns in these processes. Interested students should meet with an advisor for specific course requirements.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSI 109</td>
<td>Introduction to Communication Disorders</td>
<td>3</td>
</tr>
<tr>
<td>COSI 313</td>
<td>Language Development</td>
<td>3</td>
</tr>
<tr>
<td>COSI 325</td>
<td>Anatomy and Physiology of Speech and Hearing Mechanism</td>
<td>3</td>
</tr>
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</table>

Two of the following courses: 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSI 211</td>
<td>Phonetics and Phonology</td>
<td></td>
</tr>
<tr>
<td>COSI 220</td>
<td>Introduction to American Sign Language I</td>
<td></td>
</tr>
<tr>
<td>COSI 321</td>
<td>Speech and Hearing Science</td>
<td></td>
</tr>
<tr>
<td>COSI 345</td>
<td>Communication and Aging</td>
<td></td>
</tr>
</tbody>
</table>

Total Units 15

### Communication for Health Professionals Minor

The communication for health professionals minor offers introductory and advance study in theoretical and practical application of communication within a health context. It includes a variety of additional courses that students can choose according to their specific areas of interest. The course work is designed to appeal to students in such fields as pre-med, nursing, pre-law, public policy, public health, communication disorders, gerontological studies, nutrition, health management, and social work.

The minor requires 15 credit hours of course work, of which 9 credit hours come from required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSI 101</td>
<td>Introduction to Health Communication</td>
<td>3</td>
</tr>
<tr>
<td>COSI 109</td>
<td>Introduction to Communication Disorders</td>
<td>3</td>
</tr>
<tr>
<td>COSI 340</td>
<td>Advanced Health Communication</td>
<td>3</td>
</tr>
</tbody>
</table>

Two of the following: 6

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSI 200</td>
<td>Interpersonal Communication</td>
<td></td>
</tr>
<tr>
<td>COSI 260</td>
<td>Multicultural Aspects of Human Communication</td>
<td></td>
</tr>
<tr>
<td>COSI 280</td>
<td>Organizational Communication</td>
<td></td>
</tr>
<tr>
<td>COSI 332</td>
<td>Persuasion</td>
<td></td>
</tr>
<tr>
<td>COSI 345</td>
<td>Communication and Aging</td>
<td></td>
</tr>
</tbody>
</table>

Total Units 15

### Psychology

#### Undergraduate Programs

#### Major in Psychology

(Effective July 1, 2014 for those students who matriculate Fall 2014 or later)

An undergraduate major in psychology provides preparation for graduate training in psychology, medicine, social work, allied health professions, education, business, computer science, or law. The undergraduate degree directly prepares students for careers that require knowledge and understanding of behavior, research design, and the ability to collect, analyze, and interpret data.

#### Requirements for a Psychology Major

Beginning with Allport (1937), scientific psychology has historically relied on two broad complementary traditions in the study of human behavior. The nomothetic or experimental approach focuses on identifying general laws about human behavior. The idiographic approach is concerned with the uniqueness of people and focuses on differences among individuals. Although all psychology courses apply both perspectives to specific topics in psychology, subsets of psychology courses rely more heavily on one or the other; therefore, the major requirements below ensure training that reflects a balance of nomothetic and idiographic approaches.

The psychology major requires a total of 30 credit hours consisting of PSCL 101 General Psychology I and PSCL 282 Quantitative Methods in Psychology; two nomothetic courses; and two idiographic courses. The remaining 12 credits of elective course work can be drawn from any combination of PSCL courses.

Psychology majors must complete 30 hours of course work in the department.

Take the 2 required core courses below (total of 6 credit hours)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSCL 101</td>
<td>General Psychology I</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 282</td>
<td>Quantitative Methods in Psychology</td>
<td>3</td>
</tr>
</tbody>
</table>
**Department of Psychological Sciences**

**Integrated Graduate Studies Program:** The IGS Program enables qualified undergraduates to complete the academic work for a BA and MA degree in four years. Students accepted into the program must complete at least 30 credit hours of graduate coursework during their senior year, plus a thesis or comprehensive exam, for a Master of Arts in General Psychology. The minimum standards for acceptance are:

- an overall GPA of 3.2
- completion of the Arts and Sciences General Education or SAGES Requirements and two semesters of physical education
- 90 semester hours of undergraduate credit (the last 60 hours must have been earned while the student was in residence at CWRU)
- completion of the psychology major requirements with at least a 3.2 GPA

Students should meet with their major advisor and with Dean Claudia Anderson in the Office of Undergraduate Studies during the fall semester of their junior year to receive pre-approval for eligibility for the IGS Program.

Participation in the IGS Program does not preclude involvement in the department's honors program. For more information, consult the IGS Program section of this bulletin (p. 1078) or contact Dr. Heath Demaree.

**Communication Sciences**

**Master of Arts**

The principal goal of the Master of Arts program is to develop clinical scientists who are skilled in the management of individuals with speech and language disorders. The master's Communication Sciences education program in speech-language pathology at Case Western Reserve University is accredited by the Council on Academic Accreditation in Audiology and Speech-Language Pathology (CAA) of the American Speech-Language-Hearing Association, 2200 Research Boulevard #310, Rockville, Maryland 20850, 800-498-2071 or 301-296-5700. Upon successful completion of the Master of Arts degree, students will also meet the academic and clinical practicum requirements for certification by ASHA and licensure in the State of Ohio.

Degree requirements include completion of 42 credit hours of course work and a clinical practicum in communication disorders. In addition, students must satisfactorily complete a clinical research project or write a master's thesis.

**Clinical Opportunities in Speech, Language, and Hearing Disorders**

The program is affiliated with, and located in, Cleveland Hearing & Speech Center (CHSC), a nonprofit agency that serves children and adults with communication disorders. CHSC serves as the primary training site for graduate students enrolled in clinical practice. Its personnel and facilities provide exceptional clinical experiences for students seeking clinical certification in speech-language pathology.

The program also draws on clinical resources in University Circle and the Greater Cleveland area. In addition to clinical practicum experiences at CHSC, graduate students complete at least two externships at sites including University Hospitals of Cleveland, Rainbow Babies and
and theory and prepare them for careers as researchers, teachers, and practitioners. The Master of Arts degree can be earned in the department as part of work toward a doctorate.

**Doctor of Philosophy**

The Doctor of Philosophy is awarded in recognition of (1) mastery, at an advanced level, of a body of knowledge in the disciplines of communication sciences and speech-language pathology, and (2) a demonstrated ability to perform independent research and communicate the results of that research. With the major advisor, the student designs an individual plan of study based on his/her professional goals and previous experience. Doctoral students choose a content area (such as communication and aging, medically based speech disorders, or child language development and disorders) as their primary focus of study. However, they are also encouraged to enhance their scholarly preparation by completing course work outside of their primary content area.

In addition to course work within the department, doctoral students may choose courses from graduate programs in other departments of the College of Arts and Sciences, as well as from several professional schools at the university, including the School of Medicine (e.g., neuroscience, genetics), the Case School of Engineering (e.g., biomedical engineering), the School of Dental Medicine, the Weatherhead School of Management, and the Jack, Joseph, and Morton Mandel School of Applied Social Sciences.

Requirements for the doctoral program include course work, research rotations, a supervised classroom teaching experience, written and oral comprehensive examinations, and a dissertation.

- A minimum of 36 hours of course work is required, including 9 credit hours in statistics and research design and 3 credit hours of directed study and research. Fifteen credit hours in the primary content area are required.
- Two research rotations are required. One rotation is completed in the primary content area with the major advisor. The second rotation is completed with a faculty member other than the major advisor. The dissertation research is not included in either of the two research rotations.
- A supervised classroom teaching experience is completed under the guidance of a faculty member in the program.
- Written and oral examinations are taken after all course work and research rotations are completed.
- A dissertation prospectus is prepared under the guidance of a committee consisting of the dissertation advisor and two additional faculty members. A defense of the dissertation prospectus is required prior to commencing the dissertation study.
- An oral defense of the dissertation takes place at the end of the doctoral program.

Additional information about graduate work in communication sciences is available on the program’s website (http://psychsciences.case.edu/graduate).

**Department Faculty**

Heath A. Demaree, PhD  
(Virginia Tech)  
**Professor and Chair**  
Cerebral and psychophysiological bases of emotion

Lauren Calandruccio, PhD  
(Syracuse University)  
**Associate Professor**  
Audiology

Ange C. B. Ciccia, PhD  
(Case Western Reserve University)  
**Associate Professor**  
Neuroscience of communication and communication disorders in adolescents/adults, with focus on traumatic brain injury

Arin M. Connell, PhD  
(Emory University)  
**Associate Professor**  
Internalizing problems; coping skills during adolescence

Anastasia Dimitropoulos, PhD  
(Vanderbilt University)  
**Associate Professor**  
Genetic syndromes involving intellectual disabilities; compulsive behavior in MR/DD; functional neuroimaging

Julie J. Exline, PhD  
(State University of New York, Stony Brook)  
**Professor**  
Social relationships; transgression; moral and religious issues

Norah C. Feeny, PhD  
(Bryn Mawr College)  
**Professor**  
Evaluation of interventions for anxiety (e.g., post-traumatic stress disorder) and mood disorders

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**Psychology**

The Department of Psychological Sciences offers full-time programs leading to a PhD in clinical or experimental psychology. These programs give students a thorough grounding in basic areas of psychological fact and theory and prepare them for careers as researchers, teachers, and practitioners.
Grover C. Gilmore, PhD  
(Johns Hopkins University)  
Professor; Dean, Jack, Joseph and Morton Mandel School of Applied Social Sciences  
Perceptual development and aging; visual information processing; memory; psychophysics

Robert L. Greene, PhD  
(Yale University)  
Professor  
Human memory and cognition

Barbara Lewis, PhD  
(Case Western Reserve University)  
Professor  
Familial and genetic bases of speech/language

Brooke Macnamara, PhD  
(Princeton University)  
Assistant Professor  
Cognitive psychology, skill acquisition, learning, human performance, working memory, cognitive control, bilingualism, and communication

T. J. McCallum, PhD  
(University of Southern California)  
Associate Professor  
Older adults; caregiving; ethnicity; stress and coping

James C. Overholser, PhD  
(Ohio State University)  
Professor  
Adult psychopathology; depression; suicide; personality disorders

Amy Przeworski, PhD  
(Pennsylvania State University)  
Associate Professor  
Anxiety disorders; emotion regulation; cultural factors in family interactions

Kathryn (Kyra) Rothenberg, PhD  
(Kent State University)  
Instructor  
Health communication

Sandra W. Russ, PhD  
(University of Pittsburgh)  
Distinguished University Professor and Louis D. Beaumont University Professor  
Creativity; affective development in children; personality assessment; coping mechanisms in children

Elizabeth J. Short, PhD  
(University of Notre Dame)  
Professor  
Cognitive psychology; applied developmental; learning disabilities

Lee A. Thompson, PhD  
(University of Colorado, Boulder)  
Professor  
Human behavior genetics; child development

Jennell Vick, PhD  
(University of Washington)  
Assistant Professor  
Study of movements of the face, lips, and tongue that generate speech; acquisition and development of speech in typically developing infants and children; impact of various disorders on speech acquisition, development, and production

Lecturers

Jennifer L. Butler, PhD  
(Case Western Reserve University)  
Full-time Lecturer  
Social psychology

Patrice O. Carothers, MS, CCC-A  
(Ithaca College)  
Part-time Lecturer  
Fluency disorders

Kathryn (Kay) McNeal, MS, CCC-SLP  
(Purdue University)  
Full-time Lecturer  
Speech-language pathology

Jean Nisenboum, MA  
(Miami University)  
Full-time Lecturer  
Dysphagia, Diagnosis of speech

Adjunct Faculty

Melissa Baker, MS, CCC-SLP  
(Bowling Green State University)  
Adjunct Instructor; Private Practice  
Speech-language pathology

Kelly Bhatnagar, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor; The Emily Program

Laura Brady, MA, CCC-A  
(Kent State University)  
Adjunct Instructor; Cleveland Hearing & Speech Center  
Audiology

Rachel Berkowitz, M.A., CCC-SLP  
Adjunct Instructor; Mayfield City School District

Jane R. Buder-Shapiro, PhD  
Adjunct Assistant Professor; private practice

Barbara Choudhury, MA, CCC-SLP  
(Case Western Reserve University)  
Adjunct Instructor; Cleveland Hearing & Speech Center  
Speech-language pathology

Kelly Christian, PhD  
(Case Western Reserve University)  
Adjunct Assistant Professor

Matthew Daly, PhD  
Adjunct Assistant Professor
Barbara Ekelman, PhD
*Adjunct Associate Professor*
Pediatrics

Michelle Foye, MA, CCC-SLP
(Kent State University)
*Adjunct Instructor, Cleveland Hearing & Speech Center*
Speech-language pathology

Thomas Frazier, PhD
(Case Western Reserve University)
*Adjunct Assistant Professor*
Autism

Nicole Gerami, MA, CCC-SLP
(Case Western Reserve University)
*Adjunct Instructor; private practice*
Speech-language pathology

Clare Gideon, PhD
*Adjunct Assistant Professor*

Robert Goldberg, PhD
*Adjunct Professor; Private Practice*

Bernard P. Henri, PhD
(Northwestern University)
*Adjunct Professor*
Fluency disorders; professional issues in speech-language pathology; health care management

Douglas Hicks, PhD
(Vanderbilt University)
*Adjunct Professor; Cleveland Clinic Foundation*
Voice disorders

Alan Ho, Ph.D.
(Case Western Reserve University)
*Adjunct Assistant Professor; Cleveland State University*

Karen Kantzes, AuD, CCC-A
(A.T. Stills University)
*Adjunct Instructor, Cleveland Hearing & Speech Center*
Audiology

Susan Klein, PhD
*Adjunct Associate Professor*

Susan M. Knell, PhD
*Adjunct Assistant Professor; Susan M. Knell, Ph.D., LLC*

Marilyn Malkin, PhD
*Adjunct Assistant Professor; private practice*

Michael Manos, PhD
(University of Arizona)
*Adjunct Assistant Professor*

Lauren Masuga, MA, CCC-SLP
(Miami University)
*Adjunct Instructor; Cleveland Hearing & Speech Center*
Speech-language pathology

AnnaMaria McLaughlin, PhD
(Case Western Reserve University)
*Adjunct Assistant Professor*

Darlene Moenter-Rodriguez, PhD
(Ohio State University)
*Adjunct Assistant Professor; Louis Stokes Cleveland VA Medical Center*
Auditory potentials

Shirley Prok
*Adjunct Instructor; Sign Language Instructor, Cleveland Hearing & Speech Center*

Jes Sellers, PhD
*Adjunct Assistant Professor; Private Practice*

Jeremy Shapiro, PhD
*Adjunct Assistant Professor; Advanced Therapy Center*

Harry Sivec, PhD
*Adjunct Assistant Professor; Northcoast Behavioral Healthcare*

Kevin Smith, Ph.D.
*Adjunct Assistant Professor; Northcoast Behavioral Healthcare System*

Sarah Spannagel, PhD
*Adjunct Assistant Professor*

Kenneth Weiss, PhD
*Adjunct Assistant Professor; Louis Stokes Cleveland VA Medical Center*

Brigid Whitford, AuD, CCC-A
(A.T. Stills University)
*Adjunct Instructor, Cleveland Hearing & Speech Center*
Audiology

Stacy Williams, PhD
*Adjunct Associate Professor*

Lucene Wisniewski, Ph.D.
*Adjunct Assistant Professor; The Emily Program*

---

**Secondary Faculty**

Richard E. Boyatzis, PhD
*Professor of Organizational Behavior, Weatherhead School of Management*

Alan Castro, PhD
*Senior Instructor; University Hospitals Case Medical Center*

Howard Hall, PsyD, PhD
*Associate Professor, School of Medicine/Rainbow Babies and Children’s Hospital*

Rebecca Hazen, PhD
*Assistant Professor, School of Medicine/Rainbow Babies and Children’s Hospital*

Leslie Heinberg, Ph.D.
*Professor; The Cleveland Clinic Lerner College of Medicine of CWRU*

Anthony Jack, PhD
(University College London)
*Associate Professor; Department of Philosophy*
Carolyn Landis, PhD  
Associate Professor, School of Medicine/Rainbow Babies and Children’s Hospital

Aarti Pyati, Ph.D.  
(University of Chicago)
Adjunct Assistant Professor; CWRU University Counseling Services

Natalie Reiss, PhD  
Clinical Instructor

Lynn Singer, PhD  
Professor, School of Medicine/University Hospitals

Terry Stancin, PhD  
Professor, School of Medicine/MetroHealth Medical Center

Thomas P. Swales, PhD  
Assistant Professor, School of Medicine/MetroHealth Medical Center

Gerry Taylor, PhD  
Professor, Department of Pediatrics, School of Medicine

Abraham Wolf, PhD  
Professor, Department of Psychiatry, School of Medicine

James M. Yokely, PhD  
Assistant Professor, Department of Psychiatry, School of Medicine

Pamela Nilsson, Ph.D.  
Clinical Instructor, Psychological & Behavioral Consultants

Richard Pazol, PhD  
Clinical Instructor, Director, University Counseling Services

David Pincus, DMH  
Clinical Assistant Professor, Department of Psychiatry, School of Medicine

Josephine Ridley, PhD  
(West Virginia University)
Clinical Instructor

Robert Smith, PhD  
Clinical Assistant Professor; Behavioral Management Associates, Inc.

Terry Tobias, PhD  
Clinical Assistant Professor; Private Practice

Stacy Williams, Ph.D.  
Adjunct Associate Professor; Private Contractor

Emeritus
Douglas K. Detterman, PhD  
(University of Alabama, Tuscaloosa)
Louis D. Beaumont University Professor Emeritus

Donald K. Freedheim, PhD  
(Duke University)
Professor Emeritus of Psychology

Jane Kessler, PhD  
(Western Reserve University)
Lucy Adams Leffingwell Professor Emerita of Psychology

Milton E. Strauss, PhD  
(Harvard University)
Professor Emeritus of Psychology

Clinical Faculty
Jennifer Anderson, PhD  
(University of Toledo)
Clinical instructor

Pediatrics

Kathleen Ashton, PhD  
(Ohio State University)
Clinical instructor

Bariatrics

Karen Kernberg Bardenstein, PhD  
Adjunct Assistant Professor; private practice

Richard A. Cirillo, PhD  
Clinical Assistant Professor; Cuyahoga County Board of Mental Health and Developmental Disabilities

Sandra L. Curry, PhD  
Clinical Assistant Professor; Department of Psychiatry, School of Medicine

Lori L. D’Angelo, PhD  
Clinical instructor; International Center for Clubhouse Development

Lisa Damour, PhD  
Clinical instructor; Private Practice

Mathew A. Fuller, PhD  
Clinical instructor; Louis Stokes Cleveland VA Medical Center

Maureen Kreick, PhD  
Clinical Instructor; Private Practice

Maryann McGlenn, PhD  
Clinical Instructor; University Counseling Services

COSI Courses
COSI 101. Introduction to Health Communication. 3 Units.
An introductory examination of the influences associated with the functions of human life, communication processes, and research related to health and the health care industry from interpersonal, cultural, and organizational communication perspectives. The course will include a review of the history and development of health communication and the understanding and application of communication theories.

COSI 109. Introduction to Communication Disorders. 3 Units.
Forty-two million Americans have some type of communication disorder. How does a person with a communication disorder cope with the challenges of daily living? This course will examine the characteristics of communication disorders via first hand and fictionalized accounts in books, films, and simulated communication disorders experiences. Topics will include disorders of speech, language, and hearing in children and adults. Effects of communication disorders on families.
COSI 200. Interpersonal Communication. 3 Units.
Communication is a primary means of initiating, maintaining, and dissolving relationships. Managing interpersonal relationships is a human concern across several contexts. Interpersonal communication is a highly interactive course whereby participants investigate the foundations, processes, and issues associated with communication in relationships. The student will become sensitized to theories and processes via traditional lectures and textbook readings. The student is also expected to participate in group discussions. The result is a continuous dialogue with others about communication processes, and outcomes. The goal of this course is to provide a forum for both investigation and increased competence.

COSI 211. Phonetics and Phonology. 3 Units.
Theoretical and applied study of the speech sounds of language. The use of the international phonetic alphabet as a tool for characterizing normal and deviant sound patterns. The linguistic structure and function of speech sound systems of both the adult and developing child.

COSI 220. Introduction to American Sign Language I. 3 Units.
This course offers basic vocabulary training and conversational interaction skills in American Sign Language. Syntactic and semantic aspects of American Sign Language will be addressed.

COSI 221. Introduction to American Sign Language II. 3 Units.
This class is taught without voice, using functional, whole language approaches and in situ experiences, emphasizing communicative competency. It emphasizes sentence structure development, classifiers, and conversational regulating behaviors. It also covers inflection, role shifting, adverbial non-manual behaviors, temporal aspects, sequencing, and includes a brief introduction to ASL English diglossia and biolinguistic aspects. There will be opportunities for discussion of deaf culture. Prereq: COSI 220.

COSI 260. Multicultural Aspects of Human Communication. 3 Units.
Introduces intercultural/interracial communication by discussing specific communication principles and by putting theory into practice by exploring differences in perception, and verbal and nonverbal communication messages. Course emphasizes relationship between communication, race, culture; nature of race and culture; and how they influence the communication process. Various theories and approaches to study of intercultural/interracial communication will be discussed, along with significant concepts, processes and considerations. Practical outcomes of intercultural/interracial encounters also will be discussed. Counts for CAS Global & Cultural Diversity Requirement.

COSI 280. Organizational Communication. 3 Units.
This course includes a review of the development of organizational communication theories and how application of theories enhances our understanding of various types of organizations. COSI 280 addresses the communication challenges faced by contemporary organizational leaders and members. Knowledge of the theories and development of analytical skills should improve students’ chances for successful interactions in diverse organizational situations and cultures.

COSI 301. Professional Speaking. 3 Units.
This course is designed to introduce students to theories and practices and to develop their abilities to speak effectively in public. Students will develop skills in organization and presentation of ideas for public and conference forums, in critical listening, and in proper use of technology. Students demonstrate abilities via written assignments, skill building exercises, oral presentations, rhetorical analysis, and group projects. The expectations in this course include high levels of participation and interaction. This is a departmental seminar course with a focus on formal presentation in settings related to health care. This course will be beneficial to students planning professions in the health sciences where responsibilities include public instruction and exposition and for those preparing for capstone presentations in the Department of Psychological Sciences programs. Activities include: 1. Readings from McKerrow et al. text, 2. Class discussions related to communication competence in differing communication settings, 3. Application opportunities to give speeches, to work in groups, and relate with others in one-on-one situations, 4. Written assignments. Counts as SAGES Departmental Seminar. Prereq: Completion of 100 level first year seminar in USFS, FSCL, FSNA, FSSO, FSSY, or FSCS and either COSI 109 or PSCL 101.

COSI 302. Instrumental Measurements in Speech Sciences. 3 Units.
This course will provide hands on experience on techniques for instrumental measurements of speech and voice parameters, for applications to assessment and diagnosis of speech and voice disorders, to linguistic analysis of speech parameters (prosodic and segmental), and to speech production modeling. In particular, instrumental measures of voice parameters will be carried out by Electroglottography; evaluation of Voice Range Profile and of perturbation of frequency (jitter) and amplitude (shimmer) of the laryngeal waveform, by dedicated KayPentax software (Visi-pitch and Voice Range Profile) and by Praat software; spectrographic analyses will be carried out by Praat software, and articulographic measurements will be performed by an AG200 Electromagnetic Articulograph. Nasalance will be measured by a KapyPentax nasometer. Emphasis on use rather than theory. All instrumentation is available at the Case Speech Production Lab. Recommended preparation: COSI 211, COSI 321/421, and COGS 203, or bases in phonetics, linguistics and speech science; also Physics and Engineering instrumentation courses are good preliminaries to this course. Offered as COSI 302 and COSI 402.

COSI 305. Neuroscience of Communication and Communication Disorders. 3 Units.
The course focus is neuroanatomy and neuropsychology related to motor control and cognition, particularly aspects of cognition involved in language functions. Topics to be addressed include: principles of neurophysiology and neurochemistry; functional neuroanatomy of the central and peripheral nervous systems; neurological and neuropsychological assessment of communication; neurodiagnostic methods. In part, the course material will be presented in a problem-based learning format. That is, normal aspects of human neuroscience will be discussed in the context of neurological disorders affecting communication. COSI 305 is an elective for undergraduate students. COSI 405 is an introduction to COSI 557 and COSI 561, and a required course for graduate students. Offered as COSI 305 and COSI 405.

COSI 313. Language Development. 3 Units.
Language acquisition theory and stages of development of syntax, semantics, pragmatics, and phonology in children. Contributions of biological, social, cognitive and environmental factors to process of language development. Information on language variation in multicultural populations. Open to majors and non-majors. Recommended prerequisite: Child Psychology. Offered as COSI 313 and COSI 413.
COSI 321. Speech and Hearing Science. 3 Units.
The course will focus on the aspects of normal speech production and perception and hearing perception. The purpose of this course is to provide a foundation in normal aspects of oral communication that will prepare students for advance study in the assessment and management of disorders of speech and hearing perception. Topics to be covered include motor speech control, aeromechanics, basic acoustics, phonatory acoustics, speech and hearing acoustics, psychoacoustics, and speech and hearing perception.Recommended preparation: COSI 325. Offered as COSI 321 and COSI 421.

COSI 325. Anatomy and Physiology of Speech and Hearing Mechanism. 3 Units.
The course will focus on normal anatomy and physiology of the body systems involved in the processes of speech, language, hearing, and swallowing including the following: the auditory, respiratory, phonatory, articulatory, resonatory, and nervous systems. In part, the course material will be presented in a problem-based learning format. That is, normal aspects of human anatomy and physiology will be discussed in the context of the disorders that affect the processes of human communication and swallowing.

COSI 332. Persuasion. 3 Units.
This survey course explores the history, theories, and dynamics of persuasion. There is an extensive focus on theoretical models of attitude change. Persuasion also plays a strong role in everyday aspects of our culture. Along these lines, we will investigate persuasion activities in everyday life from compliance gaining to media campaigns. Learning is conveyed through lecture, activities, and observation of the student's everyday life. At the end of the semester, the astute student will be literate in a variety of persuasion strategies and dynamics.

COSI 340. Advanced Health Communication. 3 Units.
Various communication processes assume a central role in the acquisition and enactment of health care. This course examines communication activity across a broad range of health care contexts. Attention will be given to provider-client communication, communication, and ethical concerns, persuasive health promotion efforts, media impact on health, and basics in health communication methodology and research. Students will consider source, message, and receiver aspects of health communication as well as cultural and illness-specific issues. Prerequisite of COSI 101 for 300-level only. Offered as COSI 340 and COSI 440. Prereq: COSI 101.

COSI 345. Communication and Aging. 3 Units.
The normal and abnormal psychobiological changes that occur during aging and their effects on communication are addressed, as are communicative interaction styles, disorders, communication, and rehabilitation practices. Graduate students are given an opportunity to incorporate information from their own disciplines in a special project, where appropriate. Offered as COSI 345 and COSI 445. Counts as SAGES Departmental Seminar.

COSI 352. Introduction to Clinical Practice in Speech-Language Pathology. 3 Units.
Clinical assessment and teaching procedures as well as the role of research/theory in clinical practice. Procedures to observe, measure, analyze communication skills. Practical application through case studies. Students complete 25 hours of observation of speech/language assessment and intervention. Prereq: COSI 211 or COSI 313.

COSI 355. Introduction to Linguistics. 3 Units.
This course provides an introduction to linguistics, with application to clinical assessment, diagnosis and therapy of language disorders. In particular, the course provides an introduction to theory and methods of linguistics: universal properties of human language; phonetic, phonological, morphological, syntactic, and semantic structures and analysis; nature and form of grammar.

COSI 357. Acquired Neurogenic Communication Disorders. 3 Units.
This course is designed to provide knowledge about the theoretical foundations, etiologies, and characterizations of acquired language-based and cognitive-communication disorders in adults. The organization of the course is designed so that we will discuss communication disorders typically associated with left hemisphere lesions (e.g., aphasia), right hemisphere lesions (e.g., RHD), frontal lobe lesions (e.g., traumatic brain injury) and mesial temporal lesions (e.g., dementia). This course is intended to provide students with a framework for considering communication disorders of diverse medical etiologies rather than specific impairment types. The course is meant to provide information that can be used as a foundation for a clinically applied course in acquired language disorders. The course will focus on critical thinking, professional presentation (both oral and written), and critical consumption of research.Recommended preparation: Instructor consent for COSI 457 only. Offered as COSI 357 and COSI 457. Prereq: COSI 109.

COSI 370. Introduction to Audiology. 3 Units.
Disorders of hearing, assessment of hearing; including behavioral and objective measures; intervention strategies; and identification programs. Offered as COSI 370 and COSI 470. Prereq: COSI 321 and COSI 325.

COSI 390. Independent Study. 1 - 6 Units.
Individual study, under the guidance of a faculty member, involving specific programs of reading, research and special projects.

COSI 395. Capstone and Honors Program. 3 Units.
Supervision in carrying out an independent research study in the student's area of interest. Offered every semester. Any student majoring in communication sciences (COSI) may take this course to fulfill the capstone requirement; qualified students may take this course to fulfill the capstone requirement AND to graduate with honors. During their Junior year, qualified COSI majors are encouraged to apply to the department’s Honors Program, which leads to a B.A. with Honors. The program's purpose is to provide students with an intensive, supervised research experience in areas of their choice. The program consists of PSCL 375 and COSI 395 and begins in the junior year, when students receive instruction in research design and methodology. This provides the foundation for students to work under close supervision with a department faculty member during the senior year. At the end of the semester, the research project is written in scholarly form, and presented for consideration of graduation with Honors. Junior majors with a minimum 3.25 average in COSI major courses are a 3.0 overall GPA may apply. The Honors Program requires a great deal of work, and only students with a serious interest in behavioral sciences should apply. Counts as SAGES Senior Capstone. Prereq: (STAT 201 or PSCL 282) and PSCL 375.
COSI 402. Instrumental Measurements in Speech Sciences. 3 Units.
This course will provide hands on experience on techniques for instrumental measurements of speech and voice parameters, for applications to assessment and diagnosis of speech and voice disorders, to linguistic analysis of speech parameters (prosodic and segmental), and to speech production modeling. In particular, instrumental measures of voice parameters will be carried out by Electrogloadography; evaluation of Voice Range Profile and of perturbation of frequency (jitter) and amplitude (shimmer) of the laryngeal waveform, by dedicated KayPentax software (Visi-pitch and Voice Range Profile) and by Praat software; spectrographic analyses will be carried out by Praat software, and articulographic measurements will be performed by an AG200 Electromagnetic Articulograph. Nasalance will be measured by a KapyPentax nasometer. Emphasis on use rather than theory. All instrumentation is available at the Case Speech Production Lab. Recommended preparation: COSI 211, COSI 321/421, and COGS 203, or bases in phonetics, linguistics and speech science; also Physics and Engineering instrumentation courses are good preliminaries to this course. Offered as COSI 302 and COSI 402.

COSI 405. Neuroscience of Communication and Communication Disorders. 3 Units.
The course focus is neuroanatomy and neurophysiology related to motor control and cognition, particularly aspects of cognition involved in language functions. Topics to be addressed include: principles of neurophysiology and neurochemistry; functional neuroanatomy of the central and peripheral nervous systems; neurological and neuropsychological assessment of communication; neurodiagnostic methods. In part, the course material will be presented in a problem-based learning format. That is, normal aspects of human neuroscience will be discussed in the context of neurological disorders affecting communication. COSI 305 is an elective for undergraduate students. COSI 405 is an introduction to COSI 557 and COSI 561, and a required course for graduate students. Offered as COSI 305 and COSI 405.

COSI 413. Language Development. 3 Units.
Language acquisition theory and stages of development of syntax, semantics, pragmatics, and phonology in children. Contributions of biological, social, cognitive and environmental factors to process of language development. Information on language variation in multicultural populations. Open to majors and non-majors. Recommended prerequisite: Child Psychology. Offered as COSI 313 and COSI 413.

COSI 421. Speech and Hearing Science. 3 Units.
The course will focus on the aspects of normal speech production and perception and hearing perception. The purpose of this course is to provide a foundation in normal aspects of oral communication that will prepare students for advance study in the assessment and management of disorders of speech and hearing perception. Topics to be covered include motor speech control, aeromechanics, basic acoustics, phonatory acoustics, speech and hearing acoustics, psychoacoustics, and speech and hearing perception. Recommended preparation: COSI 325. Offered as COSI 321 and COSI 421.

COSI 431. Medical Aspects of Developmental Disabilities: Theory and Practice. 2 Units.
The practicum provides structured training activities to help the student become proficient in birth to three assessment and intervention and infant and toddler development. This intensive training experience will provide skills that students need when working in early intervention settings. Guided observation of children and developmental domains, parent-child interaction, and family based assessment will be included.
COSI 452E. Graduate Clinical Practicum V: Medical Speech Pathology. 1 Unit.
Addresses professional issues in speech-language pathology including case management, special clinical populations, collaborating with other professionals, documentation, managed health care, and use of technology. Fifteen to thirty hours of clinic contact per week at area skilled nursing facilities, hospitals. (Maximum of 2 credits.) Recommended preparation: COSI 352, COSI 452A, COSI 452B, COSI 452C, COSI 453, and COSI 456.

COSI 453. Articulation and Phonology Disorders. 3 Units.
Overview of normal speech sound development and characterization of children with speech sound disorders. Distinctions between phonology and articulation are drawn. Theoretical as well as assessment and treatment issues are addressed.

COSI 455. Fluency Disorders. 3 Units.
Stuttering and related disorders of rhythm and prosody in terms of the symptomatology, etiology, measurement, and treatment of nonfluent speaking behavior.

COSI 456. Child Language Disorders. 3 Units.

COSI 457. Acquired Neurogenic Communication Disorders. 3 Units.
This course is designed to provide knowledge about the theoretical foundations, etiologies, and characterizations of acquired language-based and cognitive-communication disorders in adults. The organization of the course is designed so that we will discuss communication disorders typically associated with left hemisphere lesions (e.g., aphasia), right hemisphere lesions (e.g., RHD), frontal lobe lesions (e.g., traumatic brain injury) and mesial temporal lesions (e.g., dementia). This course is intended to provide students with a framework for considering communication disorders of diverse medical etiologies rather than specific impairment types. The course is meant to provide information that can be used as a foundation for a clinically applied course in acquired language disorders. The course will focus on critical thinking, professional presentation (both oral and written), and critical consumption of research. Recommended preparation: Instructor consent for COSI 457 only. Offered as COSI 357 and COSI 457.

COSI 470. Introduction to Audiology. 3 Units.
Disorders of hearing, assessment of hearing; including behavioral and objective measures; intervention strategies; and identification programs. Offered as COSI 370 and COSI 470. Prereq: COSI 325.

COSI 556. Language Disorders 2: Language and Literacy. 3 Units.
This course focuses on research-based theories of reading, cognition, language, and learning disorders in the school-age and adolescent student. Language development of the older child during the school age and adolescent years will be reviewed. Topics include the development of metalinguistic skills, the expanding lexicon, narration and discourse, and advances in syntax and morphology. The relationship of spoken language to literacy will be discussed. The course will examine common language, literacy and learning disabilities during the school age years. The student will explore interventions for word skills, reading decoding and comprehension, oral expression, vocabulary, and written languages as they apply to the Speech Language Pathologist. Assessment and intervention strategies for the school-age child and adolescent with a language/learning disorder are included. The class format includes lectures, discussions of case studies, and experiential learning through the observation of therapy with the school age/adolescent student. Prereq: COSI 456.

COSI 557. Acquired Adult Language Disorders. 3 Units.
A model relating communication impairment to activities of daily living and quality of life will serve as the study of acquired neurogenic communication disorders in adults. The focus will be on dementia, aphasia, and the communication disorders associated with traumatic brain injury and right hemisphere stroke. Knowledge about the biological basis of neurogenic communication disorders will be applied in discussion on assessment and intervention for these disorders. Prereq: COSI 405 or equivalent.

COSI 560. Medical Aspects of Speech Pathology I: Voice Disorders. 3 Units.
Aspects of normal and abnormal voice production, evaluation and management of various voice and resonance disorders.

COSI 561. Med Aspects of Speech Path II: Neuromotor and Craniofacial Anomalies. 4 Units.
Speech disorders resulting from conditions acting on motor speech production including dysarthria and apraxia will be discussed. The speech production system, diseases and acquired and congenital neuropsychological conditions that affect motor process and resulting speech disorders of phonation, articulation, resonance and prosody will be reviewed. Also covered will be the speech, language and hearing disorders stemming from craniofacial anomalies; cleft lip and palate. Principles and methods of assessment and treatment within an interdisciplinary rehabilitation framework will be reviewed for both types of disorders. Prereq: COSI 321 or COSI 421 and COSI 405 or equivalent.

COSI 562. Medical Aspects of Speech Pathology III: Dysphagia. 3 Units.
Course relates to medical speech-language pathology and includes analysis of clinical problems involving dysphagia in high risk populations. Course focus is on the anatomy and physiology of the normal swallow, dysphagia, early identification and prevention, the clinical swallow assessment, instrumental assessment and intervention in pediatric and adult populations.

COSI 580. Aural Rehabilitation. 3 Units.
The effects of hearing impairment, especially related to speech perception and language processing. Remediation and intervention strategies for hearing impaired children and adults, including speech reading, auditory training, and the use of hearing aids.

COSI 600. Special Problems and Topics. 1 - 3 Units.
Topics and instructors by arrangement of the department chair.

COSI 601. Directed Study and Research. 1 - 6 Units.
Individual study and research under the direction of a faculty member.
PSCL Courses

PSCL 101. General Psychology I. 3 Units.
Methods, research, and theories of psychology. Basic research from such areas as psychophysiology, sensation, perception, development, memory, learning, psychopathology, and social psychology.

PSCL 102. General Psychology II. 3 Units.
The applications of psychological research in normal problems of adjustment. Topics include: coping with anxiety, romance and marriage, and interpersonal behavior.

PSCL 230. Child Psychology. 3 Units.
Basic facts and principles of psychological development from the prenatal period through adolescence. Recommended preparation: PSCL 101.

PSCL 282. Quantitative Methods in Psychology. 3 Units.
The theory and application of basic methods used in the analysis of psychological data. Not available for credit to students who have completed STAT 201 or ANTH 319. Counts for CAS Quantitative Reasoning Requirement.

PSCL 313. Psychology of Personality. 3 Units.
The development and organization of personality; theories of personality and methods for assessing the person; problems of personal adjustment.

PSCL 315. Social Psychology. 3 Units.

PSCL 317. Health Psychology. 3 Units.
Examines psychological processes that affect physical health. Covers the physiological factors affecting the immune system, chronic physical disorders, pain, compliance with prescribed medical treatments, the effects of stress and coping, the effects of the patient-physician interaction, and the psychological aspects of the hospital and the health care systems. Recommended preparation: PSCL 101.

PSCL 321. Abnormal Psychology. 3 Units.

PSCL 325. Psychotherapy and Personality Change. 3 Units.
Three methods of psychotherapy (behavioral, psychoanalytic, and client-centered) are discussed. The therapy techniques and the manner by which personality change is effected are examined. Recommended preparation: PSCL 101.

PSCL 329. Adolescence. 3 Units.
Psychological perspectives on physical, cognitive, and social development. Recommended preparation: PSCL 101.

PSCL 334C. Seminar and Practicum: Hospitalized Children. 3 Units.
Supervised field placement and attendance at staff conferences in various child and adolescent settings. Regular seminar meetings. Prereq: PSCL 230.

PSCL 335C. Seminar and Practicum: Hospitalized Child. 3 Units.
Supervised field placement and attendance at staff conferences in various child and adolescent settings. Regular seminar meetings. Prereq: PSCL 230 and Junior or Senior Status.

PSCL 338. Seminar and Practicum in Adolescents. 3 Units.
Supervised field placement and attendance in early childhood, child, and adolescent settings including preschools, schools, hospitals, and neighborhood centers. This class is used to fulfill requirements by the Ohio Department of Education teacher licensure program. Recommended preparation: PSCL 101, EDUC 301, EDUC 304, and permission of program director. Offered as EDUC 338, PSCL 338, and SOCI 338.

PSCL 344. Developmental Psychopathology. 3 Units.
This course will focus on the interplay of biological, psychological, familial, and social determinants of disorders ranging from autism to delinquency and bulimia. Recommended preparation: PSCL 230 or PSCL 321.

PSCL 350. Behavior Genetics. 3 Units.
Examines the impact of both nature and nurture on human behavior. Basic quantitative genetic methodology will be covered. Current family, twin and adoption studies in the areas of personality, intelligence, alcoholism, criminality, and psychopathology will be reviewed. Recommended preparation: PSCL 101.

PSCL 352. Physiological Psychology. 3 Units.
This course is designed to teach the fundamentals of neural communication and central nervous system structure. Special attention is placed on common neurological illnesses and their psychopharmacological treatments. Neural systems underlying sensory/perceptual, motor, and higher-order cognitive processes are also explored. Offered as PSCL 352 and PSCL 403. Prereq: PSCL 101.

PSCL 353. Psychology of Learning. 3 Units.
The basic methods in the study of learning. The major theories proposed to account for the learning process. Development of the fundamental concepts and principles governing the learning process in both humans and lower animal. Recommended preparation: PSCL 101.

PSCL 355. Sensation and Perception. 3 Units.

PSCL 357. Cognitive Psychology. 3 Units.

PSCL 369. Adult Development and Aging. 3 Units.
An overview of concepts and research relating to adult development and aging. The lifespan perspective will be used in examining major developmental paradigms. Personality and cognitive lines of development will be traced across the lifespan. Data from both longitudinal and cross-sectional studies will be analyzed. Both normal and pathological aging will be discussed. Special emphasis will be given to areas of cognitive deterioration in aging. Implications for optimal adult development and aging will also be discussed.
PSCL 370. Human Intelligence. 3 Units.
Survey of individual differences in human intellect including construction and administration of intelligence tests, theories and models of intelligence, and the role of heredity and environment in intelligence and the development of intelligence. This course will also examine the relationships of cognitive abilities to intelligence and human to artificial intelligence. Recommended preparation: PSCL 101.

PSCL 375. Research Design and Analysis. 3 Units.
Conceptual and methodological issues confronted by the behavioral scientist conducting research. Major experimental designs and statistical procedures. Intuitive understanding of the mathematical operations. Majors planning to apply to graduate school in Psychology are strongly encouraged to complete this course. Counts as SAGES Departmental Seminar. Prereq: PSCL 101 and (PSCL 282 or ANTH 319 or STAT 201 or STAT 201R).

PSCL 379. Neurodevelopmental Disabilities. 3 Units.
Ways in which neurobehavioral development can go awry, the causes of such deviations, and their consequences. The course builds on basic psychological and neuroscience concepts to explore the manner in which developmental disabilities occur, ways of preventing disabilities, and approaches to ameliorating and managing disabling conditions. Recommended preparation: PSCL 101 and PSCL 230. Offered as PSCL 379 and PSCL 479.

PSCL 382. Psychological Measurement. 3 Units.

PSCL 388. Human Sexual Behavior. 3 Units.
Sex is approached as a form of personal and interpersonal behavior. A broad range of theories from social psychology will be used to explain human sexual behavior, and these will be evaluated by using facts and findings from recent research studies. Topics include sexual relationships, gender differences, promiscuity, rape and coercion, finding and choosing sex partners, sexual risk-taking, harassment, sexual identity and orientation, cultural influences and differences, evolution of sexual motivations, prostitution, pornography, and love. Prereq: PSCL 101 and PSCL 315.

PSCL 389. Emotion and Emotion Regulation. 3 Units.
This course will focus on academic research associated with emotional processes and emotion regulation. Specifically, we will answer questions like: What are emotions, and why are they important? How are emotions communicated, and how do researchers measure them? How do emotions influence one’s thinking ability, and visa-versa? What is emotion regulation? How do people differ in terms of their overall happiness and well-being, the degree to which they seek/avoid positive/negative experiences, and how they try to control their emotions? And what brain mechanisms are involved in emotional processing and emotion regulation? This course is also intended to help students read research in a thorough, critical manner, which may have a positive impact on students considering an academic career. Prereq: PSCL 101 and PSCL 352.

PSCL 390. Seminars in Psychology. 1 - 3 Units.
Surveys of special subject areas. Topics vary in response to faculty and student interests. Small group discussion. Prerequisite depends on content.

PSCL 391. Psychology Capstone Research Using Data Archives. 3 Units.
In this course, each student will derive and address a research question by identifying and analyzing archived publicly available data. Successful completion of the course will require: training in ethical research involving human participants; a critical review of the literature on a specific area of psychology with the goal of creating a research question; identification of a set of variables in a publicly available data set that can be used to address the research question, a final written research report in a format acceptable for publication in a psychological research journal, and an oral presentation of the research. Counts as SAGES Senior Capstone. Prereq: PSCL 101 and PSCL 282 or equivalent (ANTH 319, STAT 201), and PSCL 375.

PSCL 392. Capstone: Positive Psychology and Character Strengths. 3 Units.
This seminar-based course is designed to provide a senior capstone experience in the area of positive psychology and character strengths. Students will focus on one specific character strength or positive psychology concept for the class project. The project will include a literature review and critique as well as a self-reflective component. Students will present their projects in two formats: a classroom-based lecture presentation and a literature review (15-20 pages). Class periods will include a blend of lecture, discussion, and student presentations. All students will be assigned to small groups for classroom-based discussions. Assignments are designed to help students develop their projects and will focus on self-reflection, literature review skills, and effective strategies for writing, presenting, and evaluating the work of others. Counts as SAGES Senior Capstone. Prereq: Students must be seniors.

PSCL 393. Experimental Child Psychology. 3 Units.
The development of behavior from birth to adolescence. Growth of basic processes such as perception, learning, memory, intelligence, and language in the light of current theoretical models. Recommended preparation: PSCL 101.

PSCL 394. Psychology Capstone Seminar: Current Problems. 3 Units.
This seminar course will revolve around the identification and critical examination of current problems in society. Insights gained from psychological research will be applied to better understand these problems. Successful completion of the course will require critical analysis of published research, integration of information from different areas of psychology and from different disciplines, an oral presentation, and a final written research report including a literature review. Counts as SAGES Senior Capstone. Prereq: PSCL 375.

PSCL 395. Capstone and Honors Program. 3 Units.
Supervision in carrying out an independent research study in the student's area of interest. Counts as SAGES Senior Capstone. Prereq: PSCL 375.

PSCL 396. Anxiety and Depression: Symptoms, Etiology, and Treatment. 3 Units.
A research-based and writing-intensive presentation of current knowledge regarding the symptoms, etiology, and treatment of anxiety disorders and mood disorders. Counts as SAGES Departmental Seminar.

PSCL 397. Independent Study. 1 - 3 Units.
Individual study involving specific programs of reading, research, and special projects. Prereq: PSCL 101.
PSCL 398C. Child Policy Externship and Capstone. 3 Units.
Externships offered through CHST/ANTH/PSCL 398C give students an opportunity to work directly with professionals who design and implement policies that impact the lives of children and their families. Agencies involved are active in areas such as public health, including behavioral health, education, juvenile justice, childcare and/or child welfare. Students apply for the externships, and selected students are placed in local public or nonprofit agencies with a policy focus. Each student develops an individualized learning plan in consultation with the Childhood Studies Program faculty and the supervisor in the agency. Offered as CHST 398C, ANTH 398C, and PSCL 398C. Counts as SAGES Senior Capstone. Prereq: CHST 301.

PSCL 399. Evaluating Psychological Information. 3 Units.
This course is a capstone designed to encourage advanced psychology students to review the knowledge they have gained throughout their coursework and to evaluate new information using this knowledge. While many core classes focus on learning the foundations of psychology through textbook readings and lectures, this class is a seminar that focuses on engaged and active participation in discussions and assignments during class. Class work will focus on evaluating psychological research, considering psychology as a field of scientific inquiry, understanding misconceptions about psychology and psychological findings, and exercising critical thinking skills. The course will culminate for each student in a unique SAGES capstone project, including a final written report and a public presentation. Independent work outside of the classroom will focus mostly on the capstone project, though you will also complete some class readings and reflection papers. Counts as SAGES Senior Capstone. Prereq: PSCL 375.

PSCL 402. Cognition and Information Processing. 3 Units.
Aspects of cognition beyond the area of sensation and perception, involving symbolic processes, especially problems of meaning, conceiving, reasoning, judging, and thinking.

PSCL 403. Physiological Psychology. 3 Units.
This course is designed to teach the fundamentals of neural communication and central nervous system structure. Special attention is placed on common neurological illnesses and their psychopharmacological treatments. Neural systems underlying sensory/perceptual, motor, and higher-order cognitive processes are also explored. Offered as PSCL 352 and PSCL 403. Prereq: Graduate Standing or Requisites Not Met permission.

PSCL 404. Learning Theory. 3 Units.
The research literature in learning; theoretical formulations of contemporary learning theorists. Limited to graduate students.

PSCL 405. Personality Theory. 3 Units.
General problems and systematic points of view in the analysis of personality. Limited to graduate students.

PSCL 407. Research Design and Quantitative Analysis I. 3 Units.
Intermediate research design and statistical analysis used in psychological research. Statistical inference from single variables, elementary principles of probability, correlation and regression. Recommended preparation: PSCL 282.

PSCL 408. Research Design and Quantitative Analysis II. 3 Units.

PSCL 409. Advanced Social Psychology. 3 Units.
This seminar-based course provides a broad, graduate-level overview of the field of social psychology. The course draws on theory and basic research in social and personality psychology to teach basic principles of human nature that can be applied to daily life, research, and clinical/applied work. Major topic areas include the self (e.g., self-regulation; self-evaluation), social cognition and relationships (e.g., social comparison; transgression), and group processes (e.g., social influence; prejudice). The interface between social and personality psychology will also receive attention.

PSCL 410. Developmental Psychology. 3 Units.
The research literature and theoretical formulation in the area of developmental psychology. Limited to graduate students.

PSCL 412. Measurement of Behavior. 3 Units.

PSCL 418. History and Systems. 3 Units.
Historical antecedents of modern psychology.

PSCL 424. Clinical Interviewing. 3 Units.
Introduction to diagnostic and therapeutic interviewing.

PSCL 425. Methods of Assessment I. 3 Units.
Limited to graduate students in clinical psychology. Recommended preparation: Graduate standing in psychology with department permission.

PSCL 426. Methods of Assessment II. 3 Units.
Methods of psychological assessment, emphasizing personality and family function in childhood and adulthood. Recommended preparation: Limited to Grad students in Clinical Psychology. Requires approval of the Director of Clinical Training.

PSCL 429. Practicum in Assessment I. 1 Unit.

PSCL 430. Practicum in Assessment II. 1 Unit.
Recommended preparation: Approval of the Director of Clinical Training or concurrent enrollment in PSCL 426.

PSCL 431. Supervised Field Placement Year 2. 0 Unit.
Supervised training in clinical psychology in agency, hospital, or university settings. Required in Fall and Spring terms of all second year students in the clinical psychology training program. Recommended preparation: PSCL 425, PSCL 426.

PSCL 444. Developmental Psychopathology. 3 Units.
This course will focus on the interplay of biological, psychological, familial, and social determinants of disorders ranging from autism to delinquency and bulimia.

PSCL 451. Special Topics in Psychology. 1 Unit.
These 1 credit mini-courses should provide enjoyable opportunities for students to explore interesting material related to clinical psychology that has not been covered in other required courses. A primary goal is to stimulate interest and discussion in the area. Thus, students will not be expected to write term papers or take any exams. In terms of background reading, students should be provided with roughly one journal article per hour of class meeting. The course is graded pass/no pass, and grading will be based on class attendance and class participation.
PSCL 453. Seminars in Psychology. 1 - 3 Units.
A special problem or topic. Content varies with student and faculty interest. Recent offerings: creative thinking in research, community psychological, evaluation of community processes, experimental and computer methods, consultation, and psychoanalytic ego psychology.

PSCL 469. Psychology of Aging. 3 Units.
Normal psychological development in later life; psychological development in the oldest old; definitions and assessment of successful aging.

PSCL 479. Neurodevelopmental Disabilities. 3 Units.
Ways in which neurobehavioral development can go awry, the causes of such deviations, and their consequences. The course builds on basic psychological and neuroscience concepts to explore the manner in which developmental disabilities occur, ways of preventing disabilities, and approaches to ameliorating and managing disabling conditions. Recommended preparation: PSCL 101 and PSCL 230. Offered as PSCL 379 and PSCL 479.

PSCL 497. Graduate Independent Study. 1 - 9 Units.
Independent research and reading programs with individual members of the faculty.

PSCL 501. Seminar: Pediatric Psychology. 1 - 3 Units.
Seminar on current research topics, research design and methodological issues related to pediatric psychology. Introductory lectures provide an overview of research populations, methods, and practical issues appropriate to research with pediatric populations.

PSCL 502. Seminar: Pediatric Psychology. 1 - 3 Units.
Seminar examining specific topics in pediatric psychology. Topics will deal with issues of infant development. Infants at risk for disability, neuropsychology and learning disabilities, and childhood psychopathology. Recommended preparation: Limited to Graduate students in Psychology department.

PSCL 510. Psychology and Diversity. 3 Units.
Diversity and multiculturalism in psychological theory, research and practice.

PSCL 524. Advanced Psychopathology. 3 Units.
Theoretical issues and current research data bearing on major patterns of psychological disturbance.

PSCL 525. Ethical and Professional Issues in Psychology. 3 Units.
Consideration of legal and ethical principles in research and practice in clinical psychology and contemporary controversies in professional psychology. Recommended preparation: Graduate standing in Psychology

PSCL 529A. Practicum in Intervention I: Behavior Therapy. 1 Unit.
Recommended Preparation: Graduate standing in clinical psychology.

PSCL 529C. Practicum in Intervention I: Psychodynamic. 1 Unit.
Recommended preparation: Graduate standing in clinical psychology.

PSCL 530A. Practicum in Intervention II: Behavior Therapy. 1 Unit.
Recommended preparation: Graduate standing in clinical psychology.

PSCL 530C. Practicum in Intervention II: Psychodynamic. 1 Unit.
Recommended preparation: Graduate standing in clinical psychology.

PSCL 531A. Seminar in Intervention I: Behavior Therapy. 2 Units.
Theoretical issues and research on psychological interventions. Recommended preparation: Graduate standing in clinical psychology.

PSCL 531C. Seminar in Intervention I: Psychodynamic. 2 Units.
Theoretical issues and research on psychological interventions. Recommended preparation: Graduate standing in clinical psychology.

PSCL 532A. Seminar in Intervention II: Behavior Therapy. 2 Units.
Theoretical issues and research on psychological interventions. Recommended preparation: Graduate standing in clinical psychology.

PSCL 532C. Seminar in Intervention II: Psychodynamic. 2 Units.
Theoretical issues and research on psychodynamic intervention. Recommended preparation: PSCL 531C and graduate standing in clinical psychology.

PSCL 535. Child and Family Intervention. 2 Units.
A course for advanced clinical graduate students that covers psychodynamic and cognitive behavioral approaches for working with children and adolescents and systems approaches for working with families.

PSCL 536. Advanced Child and Family Intervention. 2 Units.
A course for advanced clinical graduate students that covers evidence-based approaches to child and family therapy as well as parent training. Special emphasis on empirically guided treatment planning and outcome evaluation.

PSCL 537. Child and Family Case Seminar I. 1 Unit.
Clinical graduate students in child and family field placements present and receive group supervision on ongoing cases.

PSCL 538. Child and Family Case Seminar II. 1 Unit.
Clinical graduate students in child and family field placements present and receive group supervision on ongoing cases.

PSCL 539. Supervised Field Placement Year 3. 0 Unit.
Supervised training in clinical psychology in agency, hospital, or university settings. Required in Fall and Spring terms of all third year students in the clinical psychology training program. Recommended preparation: PSCL 531A, PSCL 532A.

PSCL 540. Supervised Field Placement Year 4. 0 Unit.
Supervised training in clinical psychology in agency, hospital, or university settings. Required in Fall and Spring terms of all fourth year students in the clinical psychology training program. Recommended preparation: PSCL 531A, PSCL 532A.

PSCL 601. Special Problems. 1 - 18 Units.
(Credit as arranged.)

PSCL 651. Thesis M.A.. 1 - 18 Units.
(Credit as arranged.)

PSCL 700. Internship. 0 Unit.
Full-time predoctoral internship in clinical psychology. Required of all students in clinical psychology program. Registration requires written consent of director of clinical psychology training and must be for one calendar year.

PSCL 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Computer Science

The College of Arts and Sciences awards the Bachelor of Arts and Bachelor of Science degrees in computer science. The required courses for the majors and minor are offered by the Department of Electrical Engineering and Computer Science in the Case School of Engineering.

Undergraduate Programs

The EECS department offers programs leading to degrees in:

1. Data Science and Analytics (B.S.)
Major Requirements

2. Electrical Engineering (B.S.)
3. Systems and Control Engineering (B.S.)
4. Computer Engineering (B.S.)
5. Computer Science (B.S., B.A.)

These programs provide students with a strong background in the fundamentals of mathematics, science, and engineering. Students can use their technical and open electives to pursue concentrations in bioelectrical engineering, complex systems, automation and control, digital systems design, embedded systems, micro/nano systems, robotics and intelligent systems, signal processing and communications, and software engineering. In addition to an excellent technical education, all students in the department are exposed to societal issues, ethics, professionalism, and have the opportunity to develop leadership and creativity skills.

The Bachelor of Science degree programs in Computer Engineering, Electrical Engineering, and Systems and Control Engineering are accredited by the Engineering Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

The Bachelor of Science degree program in Computer Science is accredited by the Computing Accreditation Commission of ABET, www.abet.org (http://www.abet.org).

The Bachelor of Science program in data science and analytics provides our students with a broad foundation in the field and the instruction, skills, and experience needed to understand and handle large amounts of data that transform thinking about a collection of vast amounts of data into one that focuses on the data's conversion to actionable information. The degree program has a unique focus on real-world data and real-world applications.

This major is one of the first undergraduate programs nationwide with a unique curriculum that includes mathematical modeling, informatics, data analytics, visual analytics and project-based applications - all elements of the future emerging field of data science.

An undergraduate minor in Applied Data Science (p. 129) is administered in the Materials Science and Engineering Department.

**Bachelor of Science in Data Science and Analytics**

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

<table>
<thead>
<tr>
<th>Major Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 111</td>
</tr>
<tr>
<td>DSCI 133</td>
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<tr>
<td>DSCI 234</td>
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<td>DSCI 341</td>
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<td>DSCI 342</td>
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<td>DSCI 344</td>
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<td>DSCI 345</td>
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<tr>
<td>EECS 132</td>
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<tr>
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<td>EECS 340</td>
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<td>MATH 224</td>
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<tr>
<td>PHYS 121</td>
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<tr>
<td>PHYS 122</td>
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</tbody>
</table>

Core courses provide our students with a strong background in signal processing, systems, and analytics. Students are required to develop depth in at least one of the following technical areas: signal processing, systems, and analytics. Each data science and analytics student must complete the following requirements:

**Technical Elective Requirement**

Each student must complete 8 courses (24 credit-hours) of approved technical electives. Technical electives shall be chosen to fulfill the probability/statistics elective (1 course), the computer and data security elective (1 course), the depth requirement (3 courses), and 3 courses otherwise chosen to increase the student’s understanding of data science and analytics. Technical electives not used to satisfy the probability/statistics elective, the computer and data security elective, or the depth requirement are more generally defined as any course related to the principles and practice of data science and analytics. This includes all DSCI courses at the 200 level and above and can include courses from other programs. All non-DSCI technical electives must be approved by the student’s academic advisor.

**Depth Requirement**

Each student must show a depth of competence in one technical area by taking at least three courses from one of the following three areas. Additional courses, beyond those that are listed, may be approved by the student’s academic advisor.

**Area I: Signal Processing**

| EECS 246 | Signals and Systems 4 |
| EECS 313 | Signal Processing 3 |
| STAT 332 | Statistics for Signal Processing 3 |

**Area II: Systems**

| EECS 325 | Computer Networks I 3 |
| or EECS 425 | |

**Area III: Statistics**

| STAT 313 | Statistics for Signal Processing 3 |
### EECS 338
Intro to Operating Systems and Concurrent Programming  
4

### EECS 600
Special Topics (Cloud Computing)  
1 - 18

### Area II: Analytics
- **DSCI 390**: Machine Learning for Big Data  
  3
- **DSCI 391**: Data Mining for Big Data  
  3
- **EECS 339**: Web Data Mining  
  3
- **EECS 346**: Engineering Optimization  
  3
- **EECS 440**: Machine Learning  
  3
- **EECS 442**: Causal Learning from Data  
  3

### Computer and Data Security Elective Requirement
- **EECS 444**: Computer Security  
  3
- **MATH 408**: Introduction to Cryptology  
  3

### Statistics Requirement
- **MATH 380**: Introduction to Probability  
  3
- **STAT 325**: Data Analysis and Linear Models  
  3

### Design Requirement
- **DSCI 398**: Engineering Projects I
- **DSCI 399**: Engineering Projects II

### Suggested Program of Study: Bachelor of Science in Data Science and Analytics

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

#### First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>SAGES First Year Seminar*</td>
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<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)</td>
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<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
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<tr>
<td>Introduction to Programming in Java (EECS 132)</td>
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<td>PHED (2 half semester courses)*</td>
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<tr>
<td>SAGES University Seminar*</td>
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<tr>
<td>General Physics I - Mechanics (PHYS 121)</td>
<td>4</td>
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<tr>
<td>Calculus for Science and Engineering II (MATH 122)</td>
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<tr>
<td>Introduction to Data Science and Engineering for Majors (DSCI 133)</td>
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<tr>
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#### Second Year

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<thead>
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<tbody>
<tr>
<td>15</td>
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</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGES University Seminar*</td>
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</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)</td>
<td>4</td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223)</td>
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<tr>
<td>Structured and Unstructured Data (DSCI 234)</td>
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<tr>
<td>Discrete Mathematics (EECS 302)</td>
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<tr>
<td>Introduction to Databases: DS Major (DSCI 341)</td>
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### Third Year

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<th>Units</th>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>Introduction to Data Science Systems (DSCI 342)</td>
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<tr>
<td>Software Engineering (EECS 393)</td>
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<tr>
<td>HM/SS elective</td>
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<tr>
<td>Introduction to Data Analysis (DSCI 343)</td>
<td>3</td>
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<tr>
<td>Introduction to Linear Algebra for Applications (MATH 201)</td>
<td>3</td>
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<tr>
<td>Professional Communication for Engineers (ENGL 398)</td>
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<tr>
<td>Professional Communication for Engineers (ENGR 398)</td>
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<tr>
<td>Scalable Parallel Data Analysis (DSCI 344)</td>
<td>3</td>
</tr>
<tr>
<td>Computer and Data Security Electiveb</td>
<td>3</td>
</tr>
<tr>
<td>Files, Indexes and Access Structures for Big Data (DSCI 345)</td>
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</tr>
<tr>
<td>Technical Electivec</td>
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<td>Year Total:</td>
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### Fourth Year

<table>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tr>
<td>Technical Electivec</td>
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<tr>
<td>Technical Electivec</td>
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</tr>
<tr>
<td>DSCI 398 Senior Project I</td>
<td>4</td>
</tr>
<tr>
<td>Technical electivec</td>
<td>3</td>
</tr>
<tr>
<td>HM/SS elective</td>
<td>3</td>
</tr>
<tr>
<td>HM/SS elective</td>
<td>3</td>
</tr>
<tr>
<td>DSCI Technical electivec</td>
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</tr>
<tr>
<td>DSCI 399 Senior Project II</td>
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<tr>
<td>Technical electived</td>
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</tr>
<tr>
<td>Open elective</td>
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</tr>
<tr>
<td>Open elective</td>
<td>3</td>
</tr>
<tr>
<td>Year Total:</td>
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</tr>
</tbody>
</table>

**Total Units in Sequence:** 125

* University general education requirement

a Probability and statistics elective (MATH 380, STAT 325)
b Computer and data security elective (EECS 444, MATH 408)
c Technical electives in signal processing, systems, and analytics (see lists of approved courses under program requirements)
d Technical electives

### Minor in Data Science

An undergraduate minor in applied data science (p. 129) is administered in the Materials Science and Engineering Department.
Bachelor of Science in Electrical Engineering

The Bachelor of Science program in electrical engineering provides our students with a broad foundation in electrical engineering through combined classroom and laboratory work, and prepares our students for entering the profession of electrical engineering, as well as for further study at the graduate level.

Mission

The educational mission of the electrical engineering program is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies that will advance the general field of electrical engineering.

Program Educational Objectives

1. Graduates will be successful professionals obtaining positions appropriate to their background, interests, and education.
2. Graduates will use continuous learning opportunities to improve and enhance their professional skills.
3. Graduates will demonstrate leadership in their profession.

Student Outcomes

As preparation for achieving the above educational objectives, the BS degree program in Electrical Engineering is designed so that students attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Core courses provide our students with a strong background in signals and systems, computers, electronics (both analog and digital), and semiconductor devices. Students are required to develop depth in at least one of the following technical areas: signals and systems, solid state, computer hardware, computer software, control, circuits, robotics, and biomedical applications. Each electrical engineering student must complete the following requirements.

Major in Electrical Engineering

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

Major Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 245</td>
<td>Electronic Circuits</td>
<td>4</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 309</td>
<td>Electromagnetic Fields I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 313</td>
<td>Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EECS 321</td>
<td>Semiconductor Electronic Devices</td>
<td>4</td>
</tr>
</tbody>
</table>

Core courses provide our students with a strong background in signals and systems, computers, electronics (both analog and digital), and semiconductor devices. Students are required to develop depth in at least one of the following technical areas: signals and systems, solid state, computer hardware, computer software, control, circuits, robotics, and biomedical applications. Each electrical engineering student must complete the following requirements:

Technical Elective Requirement

Each student must complete eighteen (18) credit-hours of approved technical electives. Technical electives shall be chosen to fulfill the depth requirement (see next) and otherwise increase the student's understanding of electrical engineering. Technical electives not used to satisfy the depth requirement are more generally defined as any course related to the principles and practice of electrical engineering. This includes all EECS courses at the 200 level and above and can include courses from other programs. All non-EECS technical electives must be approved by the student's academic advisor.

Depth Requirement

Each student must show a depth of competence in one technical area by taking at least three courses from one of the following eight areas. This depth requirement may be met using a combination of the above core courses and a selection of open and technical electives.

Area I: Signals & Systems

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 313</td>
<td>Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EECS 351</td>
<td>Communications and Signal Analysis</td>
<td>3</td>
</tr>
<tr>
<td>EECS 354</td>
<td>Digital Communications</td>
<td>3</td>
</tr>
<tr>
<td>EECS 490</td>
<td>Digital Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>MATH 307</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
</tbody>
</table>

Area II: Computer Software

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 293</td>
<td>Software Craftsmanship</td>
<td>4</td>
</tr>
<tr>
<td>EECS 302</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 338</td>
<td>Intro to Operating Systems and Concurrent Programming</td>
<td>4</td>
</tr>
<tr>
<td>EECS 340</td>
<td>Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>EECS 373/473</td>
<td>Modern Robot Programming (Fall 2017)</td>
<td>4</td>
</tr>
<tr>
<td>EECS 391</td>
<td>Introduction to Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>EECS 393</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>
### Area III: Solid State
- PHYS 221 Introduction to Modern Physics 3
- EECS 321 Semiconductor Electronic Devices 4
- EECS 322/415 Integrated Circuits and Electronic Devices 3
- EECS 422 Solid State Electronics II 3

### Area IV: Control
- EECS 304 Control Engineering I with Laboratory 3
- EECS 346 Engineering Optimization 3
- EECS 374 Advanced Control and Energy Systems 3
- EECS 375 Applied Control 3

### Area V: Circuits
- EECS 245 Electronic Circuits 4
- EBME 310 Principles of Biomedical Instrumentation 3
- EECS 326 Instrumentation Electronics 3
- EECS 344 Electronic Analysis and Design 3
- EECS 371 Applied Circuit Design 4
- EECS 426 MOS Integrated Circuit Design 3

### Area VI: Computer Hardware
- EECS 281 Logic Design and Computer Organization 4
- EECS 301 Digital Logic Laboratory 2
- EECS 314 Computer Architecture 3
- EECS 315 Digital Systems Design 4
- EECS 316 Computer Design 3
- EECS 318 VLSI/CAD 4

### Area VII: Biomedical Applications
- EBME 201 Physiology-Biophysics I (and 2 of the following 4 courses) 3
- EBME 310 Principles of Biomedical Instrumentation 3
- EBME 320 Medical Imaging Fundamentals 3
- EBME 327 Bioelectric Engineering 3
- EBME 401D Biomedical Instrumentation and Signal Processing 3

### Area VIII: Robotics
- EECS 246 Signals and Systems 4
- EECS 275 Fundamentals of Robotics 4
- EECS 304 Control Engineering I with Laboratory 3
- EECS 373/473 Modern Robot Programming (Fall 2017) 4
- EECS 376 Mobile Robotics 4
- EECS 484 Computational Intelligence I: Basic Principles 3
- EECS 489 Robotics I 3

### Statistics Requirement
- STAT 332 Statistics for Signal Processing * 3

* STAT 333 Uncertainty in Engineering and Science may be substituted with approval of advisor

### Design Requirement
- EECS 398 Engineering Projects I 4
- EECS 399 Engineering Projects II 3

In consultation with a faculty advisor, a student completes the program by selecting technical and open elective courses that provide in-depth training in one or more of a spectrum of specialties, such as, control, signal processing, electronics, integrated circuit design and fabrication, and robotics. With the approval of the advisor, a student may emphasize other specialties by selecting elective courses from other programs or departments.

Additionally, math and statistics classes are highly recommended as an integral part of the student's technical electives to prepare for work in industry and government and for graduate school. The following math/statistics classes are recommended and would be accepted as approved technical electives:

- MATH 201 - Introduction to Linear Algebra
- MATH 330 - Introduction to Scientific Computing
- MATH 380 - Introduction to Probability
- STAT 412 - Statistics for Design in Engineering and Science

Other Math/Statistics may be used as technical electives with the approval of the student’s academic advisor.

Many courses have integral or associated laboratories in which students gain “hands-on” experience with electrical engineering principles and instrumentation. Students have ready access to the teaching laboratory facilities and are encouraged to use them during nonscheduled hours in addition to the regularly scheduled laboratory sessions. Opportunities also exist for undergraduate student participation in the wide spectrum of research projects being conducted in the department.

### Suggested Program of Study: Major in Electrical Engineering

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGES First Year Seminar*</td>
<td></td>
<td>4</td>
<td></td>
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<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)**</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)**</td>
<td>4</td>
<td></td>
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<tr>
<td>Elementary Computer Programming (ENGR 131)**</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td></td>
<td>3</td>
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<tr>
<td>PHED (2 half semester courses)*</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122)**</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry of Materials (ENGR 145)**</td>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>PHED (2 half semester courses)*</td>
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Year Total: 18 15
### Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122) **, b</td>
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</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223) **</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Circuits and Instrumentation (ENGR 210) **</td>
<td>4</td>
</tr>
<tr>
<td>Logic Design and Computer Organization (EECS 281)</td>
<td>4</td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
</tr>
<tr>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225) **</td>
<td>4</td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224) **</td>
<td>3</td>
</tr>
<tr>
<td>Electronic Circuits (EECS 245)</td>
<td>4</td>
</tr>
<tr>
<td>Electromagnetic Fields I (EECS 309)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Units Total:** 15

### Third Year

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>HM/SS elective **, a</td>
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</tr>
<tr>
<td>Statics and Strength of Materials (ENGR 200) **</td>
<td>3</td>
</tr>
<tr>
<td>Signals and Systems (EECS 246)</td>
<td>4</td>
</tr>
<tr>
<td>Statistics for Signal Processing (STAT 332) **</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective **</td>
<td>3</td>
</tr>
<tr>
<td>HM/SS elective **, a</td>
<td>3</td>
</tr>
<tr>
<td>Semiconductor Electronic Devices (EECS 321)</td>
<td>4</td>
</tr>
<tr>
<td>Signal Processing (EECS 313)</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective **</td>
<td>3</td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGL 398) **</td>
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<tr>
<td>Professional Communication for Engineers (ENGR 398) **</td>
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**Units Total:** 16

### Fourth Year

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>HM/SS elective **, a</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Projects I (EECS 398) **</td>
<td>4</td>
</tr>
<tr>
<td>Approved technical elective **</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective **</td>
<td>3</td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
</tr>
<tr>
<td>HM/SS elective **, a</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Projects II (EECS 399) **</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective **</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective **</td>
<td>3</td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
</tr>
</tbody>
</table>

**Units Total:** 16

### Double Major: Systems and Control & Electrical Engineering

The department also offers a double major in Systems and Control and Electrical Engineering. Students pursuing the Bachelor of Science in Electrical Engineering can take the following courses as technical and open electives to earn a second major in Systems and Control engineering:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 216</td>
<td></td>
</tr>
<tr>
<td>Fundamental System Concepts (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 304</td>
<td></td>
</tr>
<tr>
<td>Control Engineering I with Laboratory (EE, Area IV. Control), and (SC&amp;E)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 305</td>
<td></td>
</tr>
<tr>
<td>Control Engineering I Laboratory (This is the additional 1 credit-hour course needed (S&amp;CE))</td>
<td>1</td>
</tr>
<tr>
<td>EECS 324</td>
<td></td>
</tr>
<tr>
<td>Modeling and Simulation of Continuous Dynamical Systems (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 342</td>
<td></td>
</tr>
<tr>
<td>Introduction to Global Issues (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 346</td>
<td></td>
</tr>
<tr>
<td>Engineering Optimization (EE, Area IV. Control), and (SC&amp;E)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 352</td>
<td></td>
</tr>
<tr>
<td>Engineering Economics and Decision Analysis (S&amp;CE)</td>
<td>3</td>
</tr>
<tr>
<td>EECS 375</td>
<td></td>
</tr>
<tr>
<td>Applied Control (EE, Area IV. Control), and (SC&amp;E)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Hours Required for Graduation: 128**

* University general education requirement
** Engineering general education requirement
a Humanities/Social Science course

b Selected students may be invited to take PHYS 123 Physics and Frontiers I - Mechanics and PHYS 124 Physics and Frontiers II - Electricity and Magnetism in place of PHYS 121 General Physics I - Mechanics and PHYS 122 General Physics II - Electricity and Magnetism.
c Students may replace STAT 332 Statistics for Signal Processing with STAT 333 Uncertainty in Engineering and Science if approved by their advisor.
d Technical electives will be chosen to fulfill the depth requirement and otherwise increase the student’s understanding of electrical engineering. Courses used to satisfy the depth requirement must come from the department’s list of depth areas and related courses. Technical electives not used to satisfy the depth requirement are more generally defined as any course related to the principles and practice of electrical engineering. This includes all EECS courses at the 200 level and above, and can include courses from other programs. All non-EECS technical electives must be approved by the student’s advisor.
e B.S./M.S. students may double count EECS 651 M.S. Thesis to fulfill the EECS 399 requirement.
f CO-OP students may obtain design credit for EECS 399 if their co-op assignment included significant design responsibility; however, the student is still responsible for such course obligations as reports, presentations, and ethics assignments. Design credit and fulfillment of remaining course responsibilities are arranged through the course instructor.
g At least 10 of the 14 required Electrical Engineering courses (EECS 281, 245, 246, 309, 313, 321, 398, 399 and the six technical electives) in the Electrical Engineering B.S. program must be satisfied by courses in the EECS department.
**Cooperative Education Program** ([http://engineering.case.edu/coop](http://engineering.case.edu/coop)) in Electrical Engineering

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

**BS/MS Program in Electrical Engineering**

The department encourages highly motivated and qualified students to apply for admission to the five-year BS/MS Program in the junior year. This integrated program, which permits up to 9 credit hours of graduate level coursework to be counted towards both BS and MS degree requirements (including an option to substitute MS thesis work for EECS 399, the second senior project) It also offers the opportunity to complete both the Bachelor of Science in Engineering and Master of Science degrees within five years. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

**Minor in Electrical Engineering**

Students enrolled in degree programs in other engineering departments can have a minor specialization by completing the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 245</td>
<td>Electronic Circuits</td>
<td>4</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 309</td>
<td>Electromagnetic Fields I</td>
<td>3</td>
</tr>
<tr>
<td>Approved technical elective</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

**Minor in Electronics**

The department also offers a minor in electronics for students in the College of Arts and Sciences. This program requires the completion of 31 credit hours, of which 10 credit hours may be used to satisfy portions of the students’ skills and distribution requirements. The following courses are required for the electronics minor:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 131</td>
<td>Elementary Computer Programming</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 210</td>
<td>Introduction to Circuits and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
</tbody>
</table>

**Bachelor of Science in Systems and Control Engineering**

The Bachelor of Science program in systems and control engineering provides our students with the basic concepts, analytical tools, and engineering methods which are needed in analyzing and designing complex technological and non-technological systems. Problems relating to modeling, simulation, decision-making, control, and optimization are studied. Some examples of systems problems which are studied include: modeling and analysis of complex biological systems, computer control of industrial plants, developing world models for studying environmental policies, and optimal planning and management in large-scale systems. In each case, the relationship and interaction among the various components of a given system must be modeled. This information is used to determine the best way of coordinating and regulating these individual contributions to achieve the overall goal of the system.

**Mission**

The mission of the Systems and Control Engineering program is to provide internationally recognized excellence for graduate and undergraduate education and research in systems analysis, design, and control. These theoretical and applied areas require cross-disciplinary tools and methods for their solution.

**Program Educational Objectives**

1. Graduates will have applied systems methodology to multi-disciplinary projects that include technical, social, environmental, political, and/or economic factors.

2. Graduates will use systems understanding, critical thinking and problem solving skills to analyze and design engineering systems or processes that respond to technical and societal needs as demonstrated by their measured professional accomplishments in industry, government and research.

3. Graduates will facilitate multidisciplinary projects that bring together practitioners of various engineering fields in an effective, professional, and ethical manner as demonstrated by their teamwork, leadership, communication, and management skills.

**Student Outcomes**

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
• the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
• a recognition of the need for, and an ability to engage in life-long learning
• a knowledge of contemporary issues
• an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The B.S. degree program in Systems and Control Engineering is accredited by the Engineering Accreditation Commission of ABET, www.abet.org.

Major in Systems and Control Engineering
In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

Major Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 216</td>
<td>Fundamental System Concepts</td>
<td>3</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 304</td>
<td>Control Engineering I with Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>EECS 305</td>
<td>Control Engineering I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EECS 313</td>
<td>Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EECS 324</td>
<td>Modeling and Simulation of Continuous Dynamical Systems</td>
<td>3</td>
</tr>
<tr>
<td>EECS 342</td>
<td>Introduction to Global Issues</td>
<td>3</td>
</tr>
<tr>
<td>EECS 346</td>
<td>Engineering Optimization</td>
<td>3</td>
</tr>
<tr>
<td>EECS 352</td>
<td>Engineering Economics and Decision Analysis</td>
<td>3</td>
</tr>
<tr>
<td>OPRE 432</td>
<td>Computer Simulation</td>
<td>3</td>
</tr>
<tr>
<td>EECS 399</td>
<td>Engineering Projects II</td>
<td>3</td>
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</table>

Fifteen hours of approved technical electives including at least 9 hours of approved courses to constitute a depth of study

Breadth Requirement

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>MATH 201</td>
<td>Introduction to Linear Algebra for Applications</td>
<td>3</td>
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<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing</td>
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</table>

Statistics Requirement

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing *</td>
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</tbody>
</table>

* STAT 333 Uncertainty in Engineering and Science may be substituted with approval of advisor

Design Requirement

<table>
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<th>Course Title</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EECS 398</td>
<td>Engineering Projects I</td>
<td>4</td>
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</tbody>
</table>

Depth Requirement

Each student must show a depth of competence in one technical area by taking at least three courses from one of the three tracks/program concentration areas, namely energy systems, control systems and data analytics, listed below:

Track 1: Energy Systems

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EECS 368</td>
<td>Power System Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 369</td>
<td>Power System Analysis II</td>
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Track 2: Control Systems

<table>
<thead>
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<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EECS 375</td>
<td>Applied Control</td>
<td>3</td>
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<tr>
<td>EECS 374</td>
<td>Advanced Control and Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
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</table>

Track 3: Data Analytics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>EECS 339</td>
<td>Web Data Mining</td>
<td>3</td>
</tr>
<tr>
<td>STAT 325</td>
<td>Data Analysis and Linear Models</td>
<td>3</td>
</tr>
<tr>
<td>STAT 326</td>
<td>Multivariate Analysis and Data Mining</td>
<td>3</td>
</tr>
<tr>
<td>EECS 435</td>
<td>Data Mining</td>
<td>3</td>
</tr>
<tr>
<td>EECS 452</td>
<td>Random Signals</td>
<td>3</td>
</tr>
<tr>
<td>EECS 490</td>
<td>Digital Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>OPRE 433</td>
<td>Foundations of Probability and Statistics</td>
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</table>

* "Application" lists:

Business/Manufacturing Analytics:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 350</td>
<td>Operations and Systems Design</td>
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</tr>
<tr>
<td>EECS 360</td>
<td>Manufacturing and Automated Systems</td>
<td>3</td>
</tr>
<tr>
<td>BAFI 361</td>
<td>Applied Financial Analytics</td>
<td>3</td>
</tr>
<tr>
<td>MKMR 310</td>
<td>Marketing Analytics</td>
<td>3</td>
</tr>
<tr>
<td>OPMT 475</td>
<td>Supply Chain Logistics</td>
<td>3</td>
</tr>
<tr>
<td>OPMT 477</td>
<td>Enterprise Resource Planning in the Supply Chain</td>
<td>3</td>
</tr>
<tr>
<td>EECS 490</td>
<td>Digital Image Processing</td>
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</table>

Healthcare Analytics

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Hours</th>
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</thead>
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<tr>
<td>EECS 319</td>
<td>Applied Probability and Stochastic Processes for Biology</td>
<td>3</td>
</tr>
<tr>
<td>EECS 365</td>
<td>Complex Systems Biology</td>
<td>3</td>
</tr>
<tr>
<td>MATH 378</td>
<td>Computational Neuroscience</td>
<td>3</td>
</tr>
<tr>
<td>EBM 410</td>
<td>Medical Imaging Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 304</td>
<td>Fitting Models to Data: Maximum Likelihood Methods and Model Selection</td>
<td>3</td>
</tr>
<tr>
<td>SYBB 421</td>
<td>Fundamentals of Clinical Information Systems</td>
<td>3</td>
</tr>
</tbody>
</table>
The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

### First Year
<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGES First Year Seminar*</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111) **</td>
<td>4</td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121) **</td>
<td>4</td>
</tr>
<tr>
<td>Elementary Computer Programming (ENGR 131) **</td>
<td>3</td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
</tr>
<tr>
<td>PHED 101 (Physical Education)*</td>
<td>0</td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121) **a</td>
<td>4</td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122) **</td>
<td>4</td>
</tr>
<tr>
<td>Chemistry of Materials (ENGR 145) **</td>
<td>4</td>
</tr>
<tr>
<td>PHED 102 (Physical Education)*</td>
<td>0</td>
</tr>
<tr>
<td>Year Total:</td>
<td>18</td>
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</tbody>
</table>

### Second Year
<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
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<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 123) **a</td>
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<td>Statistics for Signal Processing (STAT 332)</td>
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<td>Fundamental System Concepts (EECS 216)</td>
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<td>Elementary Differential Equations (MATH 224) **</td>
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<td>Statics and Strength of Materials (ENGR 200) **</td>
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<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer (ENGR 225) **</td>
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<td>Introduction to Linear Algebra for Applications (MATH 201)</td>
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### Third Year
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<td>Modeling and Simulation of Continuous Dynamical Systems (EECS 324)</td>
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<td>Introduction to Global Issues (EECS 342)</td>
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<td>Control Engineering I with Laboratory (EECS 304)</td>
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<td>Control Engineering I Laboratory (EECS 305)</td>
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<td>Engineering Optimization (EECS 346)</td>
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<td>Signal Processing (EECS 331)</td>
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<td>Computer Simulation (OPRE 432)</td>
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### Fourth Year
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<td>Engineering Economics and Decision Analysis (EECS 352)</td>
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<td>Engineering Projects I (EECS 398) **b</td>
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<td>HM/SS elective **</td>
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<tr>
<td>Engineering Projects II (EECS 399) **b</td>
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<td>Approved technical elective**</td>
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### Total Units in Sequence: 129

### Hours Required for Graduation: 129

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<tr>
<td>** Engineering general education requirement</td>
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<tr>
<td>a Selected students may be invited to take PHYS 123 and 124 in place of PHYS 121 and 122.</td>
<td></td>
</tr>
<tr>
<td>b Co-op students may obtain design credit for one semester of Senior Project Lab if their co-op assignment includes significant design responsibility. This credit can be obtained by submitting a suitable written report and making an oral presentation on the co-op work in coordination with the senior project instructor.</td>
<td></td>
</tr>
<tr>
<td>c <strong>Technical electives</strong> from approved list of courses in the three tracks/program concentration areas (Energy systems, Control systems, and Data Analytics) listed under “Depth Requirement” above.</td>
<td></td>
</tr>
<tr>
<td>There are five technical elective courses available within the B.S. program in systems and control engineering curriculum that represent a depth of the discipline. Students can satisfy these four technical elective requirements by choosing three courses from one of the three tracks (to meet the Depth Requirement) with the fourth and fifth courses chosen from any of the three tracks listed under the Depth Requirement section above</td>
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</table>
Dual Major: Systems and Control Engineering & Electrical Engineering

From Systems and Control Engineering (S&CE) to Electrical Engineering (EE): S&CE students can earn a double major with EE by taking the following five courses as Technical Electives in the S&CE program:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
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<td>EECS 245</td>
<td>Electronic Circuits</td>
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<td>EECS 309</td>
<td>Electromagnetic Fields I</td>
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<td>EECS 321</td>
<td>Semiconductor Electronic Devices</td>
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<tr>
<td>EECS 375</td>
<td>Applied Control</td>
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</tbody>
</table>

As the three courses EECS 281, EECS 245, and EECS 321 are 4 credit-hours instead of 3, the three credit-hour “Open Elective” course in the original S&CE program is not needed.

Cooperative Education Program (http://engineering.case.edu/coop) in Systems and Control Engineering

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop.

Alternatively or additionally, students may obtain employment as summer interns.

BS/MS Program in Systems and Control Engineering

The department encourages highly motivated and qualified students to apply for admission to the five-year BS/MS Program in the junior year. This integrated program, which permits up to 9 credit hours of graduate level coursework to be counted towards both BS and MS degree requirements (including an option to substitute MS thesis work for EECS 399 Engineering Projects II, the second senior project). It also offers the opportunity to complete both the Bachelor of Science in Engineering and Master of Science degrees within five years. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

Minor Program in Systems and Control Engineering

A total of five courses (15 credit hours) are required to obtain a minor in systems and control engineering. This includes:

- EECS 246 Signals and Systems
- Three of the following four courses selected in consultation with the program minor advisor: EECS 304 Control Engineering I with Laboratory/EECS 305 Control Engineering I Laboratory; EECS 324 Modeling and Simulation of Continuous Dynamical Systems; EECS 346 Engineering Optimization; EECS 352 Engineering Economics and Decision Analysis;
- One of EECS 313 Signal Processing, EECS 351 Communications and Signal Analysis, or EECS 354 Digital Communications.

Bachelor of Science in Computer Engineering

The Bachelor of Science program in Computer Engineering is designed to give a student a strong background in the fundamentals of computer engineering through combined classroom and laboratory work. A graduate of this program will be able to use these fundamentals to analyze and evaluate computer systems, both hardware and software. A computer engineering graduate would also be able to design and implement a computer system for general purpose or embedded computing incorporating state-of-the-art solutions to a variety of computing problems. This includes systems which have both hardware and software component, whose design requires a well-defined interface between the two, and the evaluation of the associated trade-offs.

Mission

The educational mission of the computer engineering program is to graduate students who have fundamental technical knowledge of their profession along with requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies which will advance the general field of computer engineering. Core courses provide our students with a strong background in digital systems design, computer organization, hardware architecture, and digital electronics.

Program Educational Objectives

1. Graduates will be successful professionals obtaining positions appropriate to their background, interests, and education.
2. Graduates will engage in life-long learning to improve and enhance their professional skills.
3. Graduates will demonstrate leadership in their profession using their knowledge, communication skills, and engineering ability.

Student Outcomes

As preparation for achieving the above educational objectives, the BS degree program in Computer Engineering is designed so that students attain:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in life-long learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
## Major in Computer Engineering

In addition to engineering general education requirements (p. 1072) and university general education requirements (p. 1053), the major requires the following courses:

### Major Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 132</td>
<td>Introduction to Programming in Java</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 210</td>
<td>Introduction to Circuits and Instrumentation</td>
<td>4</td>
</tr>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 301</td>
<td>Digital Logic Laboratory</td>
<td>2</td>
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<tr>
<td>EECS 302</td>
<td>Discrete Mathematics</td>
<td>3</td>
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<tr>
<td>EECS 314</td>
<td>Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>EECS 315</td>
<td>Digital Systems Design</td>
<td>4</td>
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</tbody>
</table>

One of the following:
- EECS 318 VLSI/CAD
- EECS 338 Intro to Operating Systems and Concurrent Programming

### Statistics Requirement

One Statistics elective may be chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
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<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
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<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing</td>
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<tr>
<td>STAT 333</td>
<td>Uncertainty in Engineering and Science</td>
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### Design Requirement

<table>
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<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>EECS 398</td>
<td>Engineering Projects I</td>
<td>4</td>
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</tbody>
</table>

In consultation with a faculty advisor, a student completes the program by selecting technical and open elective courses that provide in-depth training in principles and practice of computer engineering. With the approval of the advisor, a student may emphasize a specialty of his/her choice by selecting elective courses from other programs or departments.

Many courses have integral or associated laboratories in which students gain “hands-on” experience with computer engineering principles and instrumentation. Students have ready access to the teaching laboratory facilities and are encouraged to use them during nonscheduled hours in addition to the regularly scheduled laboratory sessions. Opportunities also exist for undergraduate student participation in the wide spectrum of research projects being conducted in the department.

### Suggested Program of Study: Major in Computer Engineering

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

<table>
<thead>
<tr>
<th>Year</th>
<th>Units</th>
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<th>Spring</th>
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<td><strong>First Year</strong></td>
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<tr>
<td>SAGES First Year Seminar</td>
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<td>Principles of Chemistry for Engineers (CHEM 111)</td>
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<td>Calculus for Science and Engineering I (MATH 121)</td>
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<tr>
<td>Introduction to Programming in Java (EECS 132)</td>
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<td>General Physics I - Mechanics (PHYS 121)</td>
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<td>Elementary Differential Equations (MATH 224)</td>
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<td>Digital Logic Laboratory (EECS 301)</td>
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<td></td>
</tr>
<tr>
<td>Digital Logic Laboratory (EECS 301)</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Computer Architecture (EECS 314)</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Digital Systems Design (EECS 315)</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Intro to Operating Systems and Concurrent Programming (EECS 338) (or Technical elective,3)</td>
<td>4</td>
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</tr>
<tr>
<td>Year Total:</td>
<td>17</td>
<td>16</td>
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<tr>
<td><strong>Fourth Year</strong></td>
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<tr>
<td>HM/SS elective</td>
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<tr>
<td>Statistics elective</td>
<td>3</td>
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</tr>
<tr>
<td>Technical elective</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>Technical elective (or EECS 318 VLSI/CAD)</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Open elective</td>
<td>3</td>
<td>3</td>
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<tr>
<td>HM/SS elective</td>
<td>3</td>
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</tbody>
</table>
Engineering Projects I (EECS 398)\textsuperscript{d} & 4  
Technical elective\textsuperscript{a} & 3  
Open elective & 4  
Year Total: & 15  

Total Units in Sequence: & 129  

Hours Required for Graduation: 129

- University general education requirement
- Engineering general education requirement
- Technical electives are more generally defined as any course related to the principles and practice of computer engineering. This includes all EECS courses at the 200 level and above, and can include courses from other programs. All non-EECS technical electives must be approved by the student's advisor.
- The student must take either EECS 318 VLSI/CAD (Fall Semester) EECS 338 Intro to Operating Systems and Concurrent Programming (Spring Semester), or a three credit hour technical elective.
- May be taken in the Fall semester if the student would like to take EECS 399%C in the Spring semester.

Cooperative Education (http://engineering.case.edu/coop) Program in Computer Engineering

Opportunities are available for students to alternate studies with work in industry or government as a co-op student, which involves paid full-time employment over seven months (one semester and one summer). Students may work in one or two co-ops, beginning in the third year of study. Co-ops provide students the opportunity to gain valuable hands-on experience in their field by completing a significant engineering project while receiving professional mentoring. During a co-op placement, students do not pay tuition, but maintain their full-time student status while earning a salary. Learn more at engineering.case.edu/coop. Alternatively or additionally, students may obtain employment as summer interns.

BS/MS Program in Computer Engineering

Highly motivated and qualified students are encouraged to apply to the BS/MS Program which will allow them to get both degrees in five years. The BS can be in Computer Engineering or a related discipline, such as mathematics or electrical engineering. Integrating graduate study in computer engineering with the undergraduate program allows a student to satisfy all requirements for both degrees in five years. Review the Office of Undergraduate Studies BS/MS program requirements here (p. 1078).

Minor in Computer Engineering

The department also offers a minor in computer engineering. The minor has a required two course sequence followed by a two course sequence in either hardware or software aspects of computer engineering. The following two courses are required for any minor in computer engineering:

EECS 281 Logic Design and Computer Organization 4

EECS 233 Introduction to Data Structures 4

Students should note that EECS 132 Introduction to Programming in Java is a prerequisite for EECS 233 Introduction to Data Structures.

The two-course hardware sequence is:

- EECS 314 Computer Architecture 3
- EECS 315 Digital Systems Design 4

The corresponding two-course software sequence is:

- EECS 338 Intro to Operating Systems and Concurrent Programming 4
- EECS 3XX Approved by advisor 4

Computer Science Mission

The mission of the Bachelor of Science and Bachelor of Arts programs in Computer Science is to graduate students who have fundamental technical knowledge of their profession and the requisite technical breadth and communications skills to become leaders in creating the new techniques and technologies which will advance the field of computer science and its application to other disciplines.

Program Educational Objectives

1. To educate and train students in the fundamentals of computer science and mathematics, in order to analyze and solve computing problems, as demonstrated by their professional accomplishments in industry, government and graduate programs and measured within three to five years after graduation.
2. To educate students with an understanding of real-world computing needs, as demonstrated by their ability to address technical issues involving computing problems encountered in industry, government and graduate programs and measured within three to five years after graduation.
3. To train students to work effectively, professionally and ethically in computing-related professions, as demonstrated by their communications, teamwork and leadership skills in industry, government and graduate programs and measured within three to five years after graduation.

Student Outcomes

As preparation for achieving the above educational objectives, the BS and BA degree programs in Computer Science are designed so that Bachelor of Science students attain:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
- An ability to function effectively on teams to accomplish a common goal
- An understanding of professional, ethical, and social responsibilities
- An ability to communicate effectively
Core and breadth courses provide our students with the flexibility to work across many disciplines and prepare them for a variety of professions. Our curriculum is designed to teach fundamental skills and knowledge needed by all CS graduates, while providing the greatest flexibility in selecting topics. Students are also required to develop depth in at least one of the following technical areas: software engineering, algorithms and theory; computer systems, networks, and security; databases and data mining; bioinformatics; or artificial intelligence.

**Bachelor of Science in Computer Science**

The Bachelor of Science program in Computer Science is designed to give a student a strong background in the fundamentals of mathematics and computer science. The curriculum is designed to teach fundamental skills and knowledge needed by all CS graduates, while providing the greatest flexibility in selecting topics. Students are also required to develop depth in at least one of the following technical areas: software engineering, algorithms and theory; computer systems, networks, and security; databases and data mining; bioinformatics; or artificial intelligence.

**Bachelor of Arts in Computer Science**

The Bachelor of Arts program in Computer Science is a combination of a liberal arts program and a computing major. It is a professional program in the sense that graduates can be employed as computer professionals, but it is less technical than the Bachelor of Science program in Computer Science. This degree is particularly suitable for students with a wide range of interests. For example, students can major in another discipline in addition to computer science and routinely complete all of the requirements for the double major in a 4 year period. This is possible because over a third of the courses in the area are open electives. Furthermore, if a student is majoring in computer science and a second technical field such as mathematics or physics many of the technical electives will be accepted for both majors. Another example of the utility of this program is that it routinely allows students to major in computer science and take all of the pre-med courses in a four-year period.

**Major in Computer Science (BS and BA)**

**BS Degree.** Each student is required to complete a total of 14 CS courses. CS courses consist of the courses listed in the core, breadth, and depth areas below. BS students must complete: all 6 core courses; 5 of 7 breadth courses; and at least 4 courses in one of listed depth areas, including all starred courses in that area (many of these also count toward the breadth requirement). Each student is also required to complete 5 technical electives. These can be satisfied using courses from the list of approved technical electives, additional breadth or depth courses, or from other CS-related courses with prior permission from the student’s academic advisor.

**BA Degree.** Students are required to complete a total of 9 CS courses. BA students must complete: all 6 core courses; 3 of 7 breadth courses; and 4 technical electives. There is no depth requirement for the BA degree.

**Major Requirements**

In addition to engineering general education requirements (BS) (p. 1072), arts & sciences general education requirements (BA) (p. 1055) and university general education requirements (p. 1053), the major requires the following courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 132</td>
<td>Introduction to Programming in Java</td>
<td>3</td>
</tr>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 281</td>
<td>Logic Design and Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>EECS 302</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 340</td>
<td>Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>EECS 395</td>
<td>Senior Project in Computer Science</td>
<td>4</td>
</tr>
<tr>
<td>B.S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 111</td>
<td>Principles of Chemistry for Engineers</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 145</td>
<td>Chemistry of Materials</td>
<td>4</td>
</tr>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 398</td>
<td>Professional Communication for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 398</td>
<td>Professional Communication for Engineers</td>
<td>2</td>
</tr>
<tr>
<td>B.A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
</tbody>
</table>

**Breadth Requirement**

BS students are required to complete 5 of the 7 following CS breadth courses. BA students are required to complete 3 of 7.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 314</td>
<td>Computer Architecture</td>
<td>3</td>
</tr>
<tr>
<td>EECS 325</td>
<td>Computer Networks I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 338</td>
<td>Intro to Operating Systems and Concurrent Programming</td>
<td>4</td>
</tr>
</tbody>
</table>
**Statistics Requirement**

One Statistics elective may be chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 380</td>
<td>Introduction to Probability</td>
<td>3</td>
</tr>
<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
<td>3</td>
</tr>
<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
<td>3</td>
</tr>
<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>STAT 333</td>
<td>Uncertainty in Engineering and Science</td>
<td>3</td>
</tr>
</tbody>
</table>

**Depth Requirement**

Students pursuing the BS degree must demonstrate a depth of competence in one of the technical areas listed below. There is no depth requirement for the BA degree. To complete the depth requirement, students must complete four courses in one of the depth areas, including all starred courses. Recommended general background courses are listed following each area where applicable.

Breadth courses can also count toward the depth requirement. CS BS students are required to complete a total of 14 CS courses (courses listed in the core, breadth, and depth requirements) to ensure that the total number of required courses is the same irrespective of the depth area. For depth areas that have two starred courses that are also breadth courses, one additional CS course is required to reach the required total of 14. Additional CS courses taken beyond the required 14 can count toward the technical elective requirement (see below).

**Area 1: Software Engineering**

- **EECS 393**  Software Engineering *  3
- **EECS 345**  Programming Language Concepts *  3
- **EECS 293**  Software Craftsmanship  4
- **EECS 337**  Compiler Design  4
- **EECS 392**  App Development for iOS  3
- **EECS 441**  Internet Applications  3
- **EECS 444**  Computer Security  3

**Area 2: Algorithms and Theory**

- **EECS 340**  Algorithms *  3
- **EECS 343**  Theoretical Computer Science *  3
- **EECS 440**  Machine Learning  3
- **EECS 454**  Analysis of Algorithms  3
- **EECS 477**  Advanced Algorithms  3
- **MATH 408**  Introduction to Cryptology  3

Recommended preparation: MATH 380, MATH 201 or (MATH 307 and MATH 308), PHIL 306.

**Area 3: Computer Systems, Networks and Security**

- **EECS 325**  Computer Networks I *  3
- **EECS 338**  Intro to Operating Systems and Concurrent Programming *  4
- **EECS 441**  Internet Applications  3
- **EECS 337**  Compiler Design  4

**Area 4: Databases and Data Mining**

- **EECS 341**  Introduction to Database Systems *  3
- **EECS 339**  Web Data Mining  3
- **EECS 405**  Data Structures and File Management  3
- **EECS 433**  Database Systems  3
- **EECS 435**  Data Mining  3
- **EECS 440**  Machine Learning  3

**Area 5: Bioinformatics**

- **EECS 458**  Introduction to Bioinformatics *  3
- **EECS 459**  Bioinformatics for Systems Biology *  3
- **EECS 341**  Introduction to Database Systems  3
- **EECS 435**  Data Mining  3
- **EECS 440**  Machine Learning  3
- **EECS 454**  Analysis of Algorithms  3

Recommended breadth and preparation: STAT 325 or EPBI 431, SYBB 311, BIOL 214. Students completing the bioinformatics depth area are only required to complete two out the three starred courses plus two additional courses on the list.

**Area 6: Artificial Intelligence**

- **EECS 391**  Introduction to Artificial Intelligence *  3
- **EECS 440**  Machine Learning  3
- **EECS 442**  Causal Learning from Data  3
- **EECS 484**  Computational Intelligence I: Basic Principles  3
- **EECS 491**  Artificial Intelligence: Probabilistic Graphical Models  3
- **EECS 496**  Artificial Intelligence: Sequential Decision Making  3
- **EECS 497**  Artificial Intelligence: Statistical Natural Language Processing  3
- **EECS 499**  Algorithmic Robotics  3
- **EECS 531**  Computer Vision  3

Recommended breadth and preparation: MATH 201, MATH 380, and either EECS 416 or EECS 477.

**Technical Electives**

Computer Science BS students are required to complete a total of 5 technical electives, totaling at least 14 credit hours; CS BA students are required to complete 4, totaling at least 11 credit hours. Technical electives are divided into two groups according to how closely a course is related to the core knowledge areas as defined in the ACM/IEEE computer science curriculum guidelines. CS students may complete any (or all) of their technical electives from group 1 and have the option to satisfy up to two of their technical electives from group 2. Students may also satisfy any of their technical elective requirements by taking additional breadth or depth courses listed above. CS-related courses not listed below may count toward the technical elective requirement but require prior permission from the student’s academic advisor.
Bachelor of Science
Suggested Program of Study: Major in Computer Science

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Fundamentals of Robotics</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>EECS 275</td>
<td>Introduction to Computer Game Design and Implementation</td>
<td>3</td>
</tr>
<tr>
<td>EECS 290</td>
<td>Digital Logic Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>EECS 301</td>
<td>Digital Systems Design</td>
<td>4</td>
</tr>
<tr>
<td>EECS 315</td>
<td>Computer Design</td>
<td>3</td>
</tr>
<tr>
<td>EECS 316</td>
<td>VLSI/CAD</td>
<td>4</td>
</tr>
<tr>
<td>EECS 318</td>
<td>Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 366</td>
<td>Mobile Robotics</td>
<td>4</td>
</tr>
<tr>
<td>EECS 376</td>
<td>Advanced Game Development Project</td>
<td>3</td>
</tr>
<tr>
<td>EECS 390</td>
<td>Computer System Architecture</td>
<td>3</td>
</tr>
<tr>
<td>EECS 419</td>
<td>Embedded Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>EECS 488</td>
<td>Digital Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>EECS 490</td>
<td>Electromagnetic Fields I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 305</td>
<td>Control Engineering I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EECS 309</td>
<td>Control Engineering I with Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>EECS 313</td>
<td>Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EECS 319</td>
<td>Applied Probability and Stochastic Processes for Biology</td>
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</tr>
<tr>
<td>EECS 324</td>
<td>Modeling and Simulation of Continuous Dynamical Systems</td>
<td>3</td>
</tr>
<tr>
<td>EECS 354</td>
<td>Digital Communications</td>
<td>3</td>
</tr>
<tr>
<td>EECS 375</td>
<td>Applied Control</td>
<td>3</td>
</tr>
<tr>
<td>EECS 408</td>
<td>Introduction to Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>EECS 413</td>
<td>Nonlinear Systems I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 489</td>
<td>Robotics I</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 210</td>
<td>Introduction to Circuits and Instrumentation</td>
<td>4</td>
</tr>
<tr>
<td>MATH 201</td>
<td>Introduction to Linear Algebra for Applications</td>
<td>3</td>
</tr>
<tr>
<td>MATH 203</td>
<td>Elementary Number Theory</td>
<td>3</td>
</tr>
<tr>
<td>MATH 207</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 208</td>
<td>Introduction to Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 303</td>
<td>Introduction of Scientific Computing</td>
<td>3</td>
</tr>
<tr>
<td>MATH 406</td>
<td>Mathematical Logic and Model Theory</td>
<td>3</td>
</tr>
<tr>
<td>MATH 413</td>
<td>Graph Theory</td>
<td>3</td>
</tr>
<tr>
<td>MATH 431</td>
<td>Introduction to Numerical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 201</td>
<td>Introduction to Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 306</td>
<td>Mathematical Logic and Model Theory</td>
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</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
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<tr>
<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
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<tr>
<td>STAT 345</td>
<td>Theoretical Statistics I</td>
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<tr>
<td>STAT 346</td>
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<th>Group 2</th>
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<tr>
<td>EECS 245</td>
<td>Signals and Systems</td>
<td>4</td>
</tr>
<tr>
<td>EECS 246</td>
<td>Control Engineering I with Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>EECS 305</td>
<td>Electromagnetic Fields I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 313</td>
<td>Applied Control</td>
<td>3</td>
</tr>
<tr>
<td>EECS 319</td>
<td>Applied Probability and Stochastic Processes for Biology</td>
<td>3</td>
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<tr>
<td>EECS 324</td>
<td>Modeling and Simulation of Continuous Dynamical Systems</td>
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<td>Digital Communications</td>
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<td>Applied Control</td>
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<tr>
<td>EECS 408</td>
<td>Introduction to Linear Systems</td>
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</tr>
<tr>
<td>EECS 413</td>
<td>Nonlinear Systems I</td>
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</tr>
<tr>
<td>EECS 489</td>
<td>Robotics I</td>
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<tr>
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<td>Introduction to Circuits and Instrumentation</td>
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<tr>
<td>MATH 201</td>
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<td>MATH 203</td>
<td>Elementary Number Theory</td>
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<td>Linear Algebra</td>
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<tr>
<td>MATH 208</td>
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<td>Introduction of Scientific Computing</td>
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<td>MATH 406</td>
<td>Mathematical Logic and Model Theory</td>
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</tr>
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<td>MATH 413</td>
<td>Graph Theory</td>
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<tr>
<td>MATH 431</td>
<td>Introduction to Numerical Analysis I</td>
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<tr>
<td>PHIL 201</td>
<td>Introduction to Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 306</td>
<td>Mathematical Logic and Model Theory</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
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</tr>
<tr>
<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
<td>3</td>
</tr>
<tr>
<td>STAT 345</td>
<td>Theoretical Statistics I</td>
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First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
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<tbody>
<tr>
<td>SAGES First Year Seminar*</td>
<td>4</td>
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</tr>
<tr>
<td>Principles of Chemistry for Engineers (CHEM 111)</td>
<td>4</td>
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</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
<td>4</td>
<td></td>
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<tr>
<td>Introduction to Programming in Java (EECS 132)</td>
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</tr>
<tr>
<td>PHED (2 half semester courses)*</td>
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</tr>
<tr>
<td>Open elective</td>
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<td></td>
</tr>
<tr>
<td>SAGES University Seminar*</td>
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</tr>
<tr>
<td>General Physics I - Mechanics (PHYS 121)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Chemistry of Materials (ENGR 145)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PHED (2 half semester courses)*</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>18</td>
<td>15</td>
</tr>
</tbody>
</table>

Second Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGES University Seminar*</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Physics II - Electricity and Magnetism (PHYS 122)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Introduction to Data Structures (EECS 233)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Discrete Mathematics (EECS 302)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Logic Design and Computer Organization (EECS 281)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Statistics elective(a)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective(b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HM/SS elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>17</td>
<td>16</td>
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</tbody>
</table>

Third Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algorithms (EECS 340)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Breadth elective(c)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Breadth elective(c)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective(b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HM/SS elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGL 398)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Professional Communication for Engineers (ENGR 398)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Breadth elective(c)</td>
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<tr>
<td>Breadth elective(c)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Depth elective(d)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>
### Fourth Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadth elective(^c)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Depth elective(^d)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective(^b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective(^b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Senior Project in Computer Science (EECS 395)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS course elective(^e)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective(^b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Technical elective(^b)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 127

### Hours Required for Graduation: 127

\(^a\) University general education requirement

\(^b\) Chosen from the list of CS technical electives. All other technical electives must be approved by the student's advisor.

\(^c\) Each student must complete 5 of the 7 following courses: EECS 314, EECS 325, EECS 338, EECS 341, EECS 345, EECS 391, and EECS 393. EECS 338 is a 4 unit course.

\(^d\) Each student must complete 4 courses in one of the technical depth areas listed above, including all starred courses.

\(^e\) Needed to complete the requirement of 14 CS courses. This can be an additional breadth or depth course, depending on what is needed to satisfy the depth requirement.

### Bachelor of Arts

**Suggested Program of Study: Major in Computer Science**

The following is a suggested program of study. Current students should always consult their advisers and their individual graduation requirement plans as tracked in SIS (http://sis.case.edu).

### First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAGES First Year Seminar(^*)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I (MATH 125)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Introduction to Programming in Java (EECS 132)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HM/SS elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHED (2 half semester courses)(^*)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>SAGES University Seminar(^*)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II (MATH 126)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>HM/SS elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Open elective</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Year Total: 15 16

Total Units in Sequence: 120

### Hours Required for Graduation: 120

\(^*\) University general education requirement
Cognitive Science Track (requires 3 of the following courses):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 373</td>
<td>Introduction to Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 374</td>
<td>Neurobiology of Behavior</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 301</td>
<td>Linguistic Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 201</td>
<td>Introduction to Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 306</td>
<td>Mathematical Logic and Model Theory</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 101</td>
<td>General Psychology I</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 352</td>
<td>Physiological Psychology</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 353</td>
<td>Psychology of Learning</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 355</td>
<td>Sensation and Perception</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 357</td>
<td>Cognitive Psychology</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 370</td>
<td>Human Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 402</td>
<td>Cognition and Information Processing</td>
<td>3</td>
</tr>
</tbody>
</table>

Minor in Computer Gaming (CGM)

The minor is 16 hours as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EECS 233</td>
<td>Introduction to Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>EECS 290</td>
<td>Introduction to Computer Game Design and Implementation</td>
<td>3</td>
</tr>
<tr>
<td>EECS 366</td>
<td>Computer Graphics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 390</td>
<td>Advanced Game Development Project</td>
<td>3</td>
</tr>
<tr>
<td>EECS 391</td>
<td>Introduction to Artificial Intelligence</td>
<td>3</td>
</tr>
</tbody>
</table>

Artificial Intelligence. Students who take the Artificial Intelligence minor must also take an additional three courses from one of two minor tracks.

Technology Track (requires 3 of the following courses):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 373</td>
<td>Introduction to Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 374</td>
<td>Neurobiology of Behavior</td>
<td>3</td>
</tr>
<tr>
<td>EECS 477</td>
<td>Advanced Algorithms</td>
<td>3</td>
</tr>
<tr>
<td>EECS/BIOL 478</td>
<td>Computational Neuroscience</td>
<td>3</td>
</tr>
<tr>
<td>EECS 350</td>
<td>Operations and Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>EECS 352</td>
<td>Engineering Economics and Decision Analysis</td>
<td>3</td>
</tr>
<tr>
<td>EECS 360</td>
<td>Manufacturing and Automated Systems</td>
<td>3</td>
</tr>
<tr>
<td>EECS 375</td>
<td>Applied Control</td>
<td>3</td>
</tr>
<tr>
<td>EECS 411</td>
<td>Applied Engineering Statistics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 475</td>
<td>Applied Control</td>
<td>3</td>
</tr>
<tr>
<td>EECS 484</td>
<td>Computational Intelligence I: Basic Principles</td>
<td>3</td>
</tr>
<tr>
<td>EECS 489</td>
<td>Robotics I</td>
<td>3</td>
</tr>
<tr>
<td>EECS 491</td>
<td>Artificial Intelligence: Probabilistic Graphical Models</td>
<td>3</td>
</tr>
<tr>
<td>EECS 531</td>
<td>Computer Vision</td>
<td>3</td>
</tr>
<tr>
<td>EECS 589</td>
<td>Robotics II</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 201</td>
<td>Introduction to Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 306</td>
<td>Mathematical Logic and Model Theory</td>
<td>3</td>
</tr>
</tbody>
</table>
It is recommended that one additional open elective be a “content creation” course taken from the following areas: Art, English, or Music. Students should note that EECS 132 Introduction to Programming in Java is a prerequisite for EECS 233 Introduction to Data Structures.

Department of Dance

Mather Dance Center
http://dance.case.edu/
Phone: 216.368.1491; Fax: 216.368.6936
Karen Potter, Department Chair
karen.potter@case.edu

The Department of Dance offers education and participation in many aspects of dance, with course offerings in modern dance and ballet technique, choreography, kinesiology, history, production and more. Students have the opportunity to perform onstage as well as to serve on the technical crews in dance concerts. The high ratio of faculty to students ensures that students will be able to work closely with highly skilled professionals. The department treats all performances as educational experiences and welcomes the participation of all students, particularly in Mather Dance Collective (MaDaCol), regardless of their academic majors and career goals.

Graduates of the dance program are currently employed as modern dance company members (regionally and nationally), company directors/choreographers, and dance production managers, and as teachers, program directors, and administrators in colleges and universities. Others have transitioned into such disciplines as physical therapy and massage therapies.

Undergraduate Programs

Major

Degree requirements for the major in dance, Bachelor of Arts degree, are as follows:

Technique Core (all but 103 and 160 are repeatable for credit as advised and/or desired) 21

Modern Techniques: By advisement and placement, select from among the 3-credit and floating credit classes below (15 credits):

- DANC 103 First-Year Modern Dance Techniques I
- DANC 104 First-Year Modern Dance Techniques II
- DANC 203 Second-Year Modern Dance Techniques I
- DANC 204 Second-Year Modern Dance Techniques II
- DANC 303 Third-Year Modern Dance Techniques I
- DANC 304 Third-Year Modern Dance Techniques II
- DANC 317 Advanced Modern Dance Technique I
- DANC 318 Advanced Modern Dance Technique II
- DANC 403 Fourth-Year Modern Dance Technique I

Ballet Techniques: By advisement and placement, selected from among the 3-credit and floating credit classes listed below (6 credits):

- DANC 160 Introduction to Ballet Technique I
- DANC 161 Introduction to Ballet Technique II
- DANC 260 Second-Year Ballet Technique I
- DANC 261 Second-Year Ballet Technique II
- DANC 360 Ballet Technique for Modern Dance Students I
- DANC 361 Ballet Technique for Modern Dance Students II
- DANC 460 Ballet Technique for Modern Dance Students I
- DANC 461 Ballet Technique for Modern Dance Students II

Core Theory and Creative Research Requirements 9

- DANC 355 History of Modern Dance

Select two from among:

- DANC 121 Dance in Culture - Ethnic Forms
- DANC 122 Dance in Culture - Theatrical Forms
- DANC 314 The Craft of Choreography
- DANC 345 Kinesiology for Dance

Additional Core Requirements (choose 3 from below): 9

- DANC 121 Dance in Culture - Ethnic Forms
- DANC 122 Dance in Culture - Theatrical Forms
- DANC 237 Religion and Dance in South Asia
- DANC 315 Choreography and Music
- DANC 324 Dance Production Resources
- DANC 335 Modern Dance Pedagogy
- DANC 345 Kinesiology for Dance
- DANC 346 Topics in Dance Medicine, Science, and Wellness
- DANC 396 SAGES Senior Capstone in Dance

Additional Performance/Physical Requirements 2

- DANC 385 Production Practicum (repeatable for credit)
- DANC 386 Rehearsal and Performance

Total Units 41

Departmental Honors

All majors are encouraged to apply for DANC 397 Honors Studies I and DANC 398 Honors Studies II in their final year. This adds 6 hours to the total.

Minor

- DANC 103 First-Year Modern Dance Techniques I 3
- DANC 104 First-Year Modern Dance Techniques II 3
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 203</td>
<td>Second-Year Modern Dance Techniques I</td>
<td>3</td>
</tr>
<tr>
<td>DANC 204</td>
<td>Second-Year Modern Dance Techniques II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Units</strong></td>
<td>6</td>
</tr>
</tbody>
</table>

Two of the following*: (6)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 160</td>
<td>Introduction to Ballet Technique I</td>
</tr>
<tr>
<td>DANC 161</td>
<td>Introduction to Ballet Technique II</td>
</tr>
<tr>
<td>DANC 260</td>
<td>Second-Year Ballet Technique I</td>
</tr>
<tr>
<td>DANC 261</td>
<td>Second-Year Ballet Technique II</td>
</tr>
<tr>
<td>DANC 303</td>
<td>Third-Year Modern Dance Techniques I</td>
</tr>
<tr>
<td>DANC 304</td>
<td>Third-Year Modern Dance Techniques II</td>
</tr>
<tr>
<td>DANC 360</td>
<td>Ballet Technique for Modern Dance Students I</td>
</tr>
<tr>
<td>DANC 361</td>
<td>Ballet Technique for Modern Dance Students II</td>
</tr>
</tbody>
</table>

Additional requirements: (one time)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 385</td>
<td>Production Practicum</td>
<td>0</td>
</tr>
</tbody>
</table>

* Other classes may be substituted by advisement

Total Units 18

**Graduate Programs**

**Master of Arts**

Although the graduate dance program is geared toward the Master of Fine Arts degree (see below), all graduate students begin in the MA program. Advancement to the MFA program occurs upon faculty recommendation to the Dean of Graduate Studies in the third semester. The course work for the MA may be similar to that for the Master of Fine Arts, enhanced by related studies in theater and other departments. The candidate's program of study will be designed by the primary dance faculty. As required by the School of Graduate Studies, students must maintain a minimum grade point average of 2.75. The Department of Dance requires an average of 3.0.

MA candidates must complete a minimum of 30 hours, following a program similar to that suggested below. The principal faculty advisor may suggest modifications.

**Technique Classes:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 417</td>
<td>Advanced Modern Dance Technique I</td>
<td></td>
</tr>
<tr>
<td>&amp; DANC 418</td>
<td>and Advanced Modern Dance Technique II</td>
<td>12</td>
</tr>
<tr>
<td>DANC 403</td>
<td>Fourth-Year Modern Dance Technique I</td>
<td></td>
</tr>
<tr>
<td>DANC 460</td>
<td>Ballet Technique for Modern Dance Students I</td>
<td></td>
</tr>
<tr>
<td>&amp; DANC 461</td>
<td>and Ballet Technique for Modern Dance Students II</td>
<td></td>
</tr>
</tbody>
</table>

**Choreography:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 414</td>
<td>The Craft of Choreography</td>
<td></td>
</tr>
<tr>
<td>DANC 415</td>
<td>Choreography and Music</td>
<td></td>
</tr>
<tr>
<td>DANC 416</td>
<td>Choreography and Theatrical Elements</td>
<td></td>
</tr>
</tbody>
</table>

**Dance Science:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 445</td>
<td>Kinesiology for Dance</td>
<td>4-5</td>
</tr>
</tbody>
</table>

**DANC 446** Topics in Dance Medicine, Science, and Wellness

Additional core courses, one or more courses by advisement 3-6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 535</td>
<td>Modern Dance Pedagogy</td>
</tr>
<tr>
<td>DANC 455</td>
<td>History of Modern Dance</td>
</tr>
<tr>
<td>DANC 505</td>
<td>Music Resources for Modern Dance</td>
</tr>
<tr>
<td>or DANC 424</td>
<td>Production Resources</td>
</tr>
</tbody>
</table>

Thesis or Research 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 601</td>
<td>Special Projects</td>
</tr>
<tr>
<td>or DANC 644</td>
<td>Thesis</td>
</tr>
</tbody>
</table>

**Eurhythmics** 2

Total Units 33-37

The program recommends the School of Graduate Studies’ plan B, with requirements including a non-performance, non-production thesis on a topic approved by the primary program faculty. The thesis must be a substantial contribution to the field, with potential for publication or presentation. The MA thesis must be completed no later than one academic year beyond the completion of the course requirements.

**Master of Fine Arts (Contemporary Dance)**

The Master of Fine Arts degree, available with emphasis areas in choreography, performance, pedagogy, and complementary courses in dance science, is a terminal pre-professional degree. Candidacy for the MFA program requires an undergraduate degree with (ideally) a major in dance, equivalent training and experience, or demonstrable potential for work at the MFA level. In addition, each candidate must provide evidence of technical skill and creative ability. Participation as a part-time student is not recommended.

At the end of each semester in residence, the student’s skill and creative ability are evaluated in light of his or her work in the department. Only students who have clearly demonstrated growth and excellence are permitted to remain in the program. The award of the MFA degree is contingent upon the student’s academic progress and upon the faculty’s assessment that the candidate possesses the potential to work in the field of dance on a professional level.

Requirements for the MFA degree include:

1. A minimum of 60 semester hours of graduate work beyond the bachelor’s degree
2. A cumulative grade point average of 3.0 for all course work on the graduate level
3. Completion of the course requirements for the MFA Thesis Portfolio
4. Successful completion of the third year in performance in the Mather Dance Center mainstage season

Specific requirements for the MFA degree are as follows:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANC 414</td>
<td>The Craft of Choreography</td>
<td>18</td>
</tr>
<tr>
<td>DANC 415</td>
<td>Choreography and Music</td>
<td>12</td>
</tr>
<tr>
<td>DANC 416</td>
<td>Choreography and Theatrical Elements</td>
<td>4</td>
</tr>
<tr>
<td>MUDE 501</td>
<td>Special Reading (M.M. and M.A.)</td>
<td>1</td>
</tr>
<tr>
<td>MUDE 501</td>
<td>Special Reading (M.M. and M.A.)</td>
<td>1</td>
</tr>
</tbody>
</table>

(MUDE 501 is to be taken twice for a total of 2 credit hours)

3 hours of contemporary dance history 3
Continuation of DANC 160. Prereq: DANC 160 or consent of department.

DANC 161. Introduction to Ballet Technique II. 3 Units.
A command of ballet terminology.
A strong emphasis on proper alignment of the body, dynamic timings, and a basic tenets and principles of ballet technique. Classwork will involve in-depth exploration of principles and foundations of ballet technique as preparation for the specialized training needs of dancers. Prereq: DANC 160.

DANC 160. Introduction to Ballet Technique I. 3 Units.
Building upon the movement foundations explored in first-year modern dance courses, this course introduces the formalities of dance technique as a contemporary American art form with continued and progressive refinement and development of basic movement principles, locomotor and axial skills and dance vocabulary, all in relation to time, space and dynamics and with a broad spectrum of applications, including dance, music, sports and theater. Prereq: DANC 103 and DANC 104.

DANC 260. Second-Year Ballet Technique I. 3 Units.
Continuation of DANC 260. Prereq: DANC 260.

DANC 261. Second-Year Ballet Technique II. 3 Units.
For the dance major and upper level non-major. Formalities of dance technique as a contemporary American art form serve as the basis of the aesthetic and technical challenges explored in the course. Prereq: DANC 260.

DANC 203. Second-Year Modern Dance Techniques I. 3 Units.
In-depth exploration of principles and foundations of ballet technique as preparation for the specialized training needs of dancers. Prereq: DANC 161.

DANC 204. Second-Year Modern Dance Techniques II. 3 Units.
Continuation of DANC 203. Prereq: DANC 203.

DANC 237. Religion and Dance in South Asia. 3 Units.
This is an experimental interdisciplinary course in religion, dance, and South Asian studies. We will explore the performance of religion in bharata natyam, one storytelling dance form from South Asia. This dance style draws upon Hindu devotional (bhakti) allegories of sacred and profane love in its choreography. Lover and beloved, as the ideal relationship between God and the human, becomes the model for the performed relationship between heroes and heroines (nayaka-nayaki) danced on stages and, more recently, Bollywood screens. To this end we will examine primary and secondary sources on bharata natyam and aesthetic theory/classical dramatics. We will also observe dance performances in the greater Cleveland area. Offered as RLGN 237 and DANC 237.

DANC 260. Second-Year Ballet Technique I. 3 Units.
Continuation of DANC 260. Prereq: DANC 260 or consent of department.

DANC 303. Third-Year Modern Dance Techniques I. 3 Units.
For the dance major and upper level non-major. Formalities of dance technique as a contemporary American art form serve as the basis of the aesthetic and technical challenges explored in the course. Prereq: DANC 260.

DANC 304. Third-Year Modern Dance Techniques II. 3 Units.
Continuation of DANC 303. Recommended preparation: DANC 303 or consent of department.

DANC 314. The Craft of Choreography. 3 Units.
An in-depth investigation of choreographic craft elements is presented through lecture, practical involvement and specified studies. Emphasized are tools to discover primary movement vocabulary, development of vocabulary through permutative investigations and the co-ordering of movement vocabulary into phrases, structural units, and larger sections. Offered as DANC 314 and DANC 414. Prereq: DANC 303 and DANC 304.

DANC 315. Choreography and Music. 3 Units.
Combining craft resources with emphasis on use of music. Music selections, historically categorized, are chosen for the purpose of analyzing metric and structural characteristics in accord with which choreography will be created. Offered as DANC 315 and DANC 415. Prereq: DANC 314 or requisite not met permission.

DANC 317. Advanced Modern Dance Technique I. 1 - 3 Units.
Emphasis on performing skills enlarged to include rehearsal and performance of full repertory works. Adaptability, versatility, and fidelity to choreographic intention stressed. Offered as DANC 317 and DANC 417. Prereq: DANC 304

DANC 318. Advanced Modern Dance Technique II. 1 - 3 Units.
Continuation of DANC 317/417. Offered as DANC 318 and DANC 418. Prereq: DANC 317.

Department Faculty
Karen Potter, MFA
(Case Western Reserve University)
Professor and Chair
Contemporary dance technique; choreography; pedagogy

Gary Galbraith, MFA
(Case Western Reserve University)
Professor; Artistic Director, Mather Dance Ensemble
Contemporary dance technique; choreography; dance wellness; production and technology

Shannon Sterne, MA, MS
(Case Western Reserve University)
Assistant Professor
Contemporary dance, kinesiology, dance history

Courses
DANC 103. First-Year Modern Dance Techniques I. 3 Units.
Introduction to modern dance technique, through active participation, to serve individual development of basic movement principles, locomotor and axial skills and dance vocabulary, all in relation to time, space and dynamics and with a broad spectrum of applications, including dance, music, sports and theater. Explorations and investigations, both practical and cognitive, are designed to lay an introductory foundation for participating in and appreciating and understanding creative expressions.

DANC 104. First-Year Modern Dance Techniques II. 3 Units.
Continuation of DANC 103. Prereq: DANC 103.

DANC 121. Dance in Culture - Ethnic Forms. 3 Units.
A lecture class designed to introduce dance as an art form and the many roles it plays in a variety of cultures. Focus will be on ethnic forms and primal cultures. Counts for CAS Global & Cultural Diversity Requirement.

DANC 122. Dance in Culture - Theatrical Forms. 3 Units.
An introduction to an historical and cultural overview of many different theatrical forms of dance from various cultures specifically selected to encompass geographic diversity and represent different periods in history. Basic craft elements of the structures of theatrical dance will be introduced to provide a foundation for viewing dance and developing a personal aesthetic. Counts for CAS Global & Cultural Diversity Requirement.

DANC 160. Introduction to Ballet Technique I. 3 Units.
This introductory-level course offers the beginning ballet student the basic tenets and principles of ballet technique. Classwork will involve strong emphasis on proper alignment of the body, dynamic timings, and a command of ballet terminology.

DANC 161. Introduction to Ballet Technique II. 3 Units.
Continuation of DANC 160. Prereq: DANC 160 or consent of department.
DANC 324. Dance Production Resources. 3 Units.
An examination of dance production resources such as costumes construction, lighting design, and management. Exercises include design, construction, and implementation to emphasize practical applications. Offered as DANC 324 and DANC 424.

DANC 335. Modern Dance Pedagogy. 3 Units.
The study and investigation of the approaches and methods of teaching modern dance. Detailed study is made of kinesthetic, oral, and creative factors in teaching dance. Opportunity to assist and teach under supervision. Offered as DANC 335 and DANC 535. Prereq: DANC 303 and (DANC 345 or DANC 314).

DANC 345. Kinesiology for Dance. 3 Units.
Seminar and laboratory for assessment of kinesiological and biomechanical principles as related to dance. Assessment of current research will be implemented to affect cross-training protocols. Offered as DANC 345 and DANC 445.

DANC 346. Topics in Dance Medicine, Science, and Wellness. 1 - 3 Units.
Review and application of continually emerging information from the fields of Dance Medicine and Science that impacts general dancer health and the care and prevention and treatment of dance specific injuries. Participation in the Dancer Wellness Program is encouraged to facilitate continued application of principles developed in DANC 345. Offered as DANC 346 and DANC 446.

DANC 355. History of Modern Dance. 3 Units.
Origins and development of contemporary dance in its historical context. Counts as SAGES Departmental Seminar. Prereq: 100 level first year seminar in USFS, FSCC, FSNA, FSSO, FSSY, or FSCS. Prereq or Coreq: FSTS 100.

DANC 360. Ballet Technique for Modern Dance Students I. 1 - 3 Units.
Ballet Technique for Dancers will focus on developing the ballet skills required of the Modern Dance major. The technical level of the class will range from intermediate to advanced where applicable in barre work as well as center. Offered as DANC 360 and DANC 460. Prereq: DANC 261.

DANC 361. Ballet Technique for Modern Dance Students II. 1 - 3 Units.
Ballet Technique for Dancers will focus on developing the ballet skills required of the Modern Dance major. The technical level of the class will range from intermediate to advanced where applicable in barre work as well as center. Offered as DANC 361 and DANC 461. Prereq: DANC 360.

DANC 385. Production Practicum. 0 - 1 Units.
Practicum for students participating in production work in the Department of Dance. Supervised laboratory experience in technical theater; construction techniques, scenery, costumes, lighting, and props; production; ticket office operations, promotion, publicity and public relations; house management; wardrobe responsibilities; stage management; assistant directing; and other production positions.

DANC 386. Rehearsal and Performance. 0 Unit.
Practicum for students participating in performance in the Department of Dance, relating to the mainstage productions at Mather Dance Center.

DANC 396. SAGES Senior Capstone in Dance. 3 Units.
This capstone course, the final requirement of the SAGES program, is limited to students majoring in Dance. As it is not required of the major, enrollment will be based on the recommendation of the student’s major advisor. Projects may focus on creative or scholarly research, both of which require a written component that culminates in a formal presentation. Creative projects are only available to students who have successfully completed DANC 314, DANC 315, and DANC 324, who have also consistently excelled in their upper-level modern technique classes, and who have been recommended by the faculty of the Department of Dance to undertake a creative project versus a scholarly project. Except in approved situations, all capstone projects are supervised by a faculty person in the Department of Dance. Counts as SAGES Senior Capstone. Prereq: DANC 203, DANC 204, DANC 303, DANC 304, DANC 314 and DANC 355.

DANC 397. Honors Studies I. 3 Units.
Individual projects in dance.

DANC 398. Honors Studies II. 3 Units.
Individual projects in dance.

DANC 399. Independent Study in Dance. 1 - 3 Units.
Independent research and project work in areas of dance and pedagogy.

DANC 403. Fourth-Year Modern Dance Technique I. 1 - 3 Units.
A logical progression of modern technique, this class is designed for the upper level dance major and graduate student in dance to further develop technical acumen with emphasis on aesthetic and physical challenges. Prereq: DANC 303.

DANC 404. Fourth-Year Modern Dance Technique II. 1 - 3 Units.
Continuation of DANC 403. Prereq: DANC 403.

DANC 414. The Craft of Choreography. 3 Units.
An in-depth investigation of choreographic craft elements is presented through lecture, practical involvement and specified studies. Emphasized are tools to discover primary movement vocabulary, development of vocabulary through permutative investigations and the co-ordering of movement vocabulary into phrases, structural units, and larger sections. Offered as DANC 314 and DANC 414.

DANC 415. Choreography and Music. 3 Units.
Combining craft resources with emphasis on use of music. Music selections, historically categorized, are chosen for the purpose of analyzing metric and structural characteristics in accord with which choreography will be created. Offered as DANC 315 and DANC 415. Prereq: DANC 414.

DANC 416. Choreography and Theatrical Elements. 3 Units.
Use of properties, costumes, and scenic elements in both "first- and second-function" (Northrop) or "literal" and "abstract" applications challenge the functional and aesthetic appropriateness of conjoined choices. Dance structures fully developed under supervision. Successful results may be programmed for performance and tested for applicability to the Production sequence. Prereq: DANC 414.

DANC 417. Advanced Modern Dance Technique I. 1 - 3 Units.
Emphasis on performing skills enlarged to include rehearsal and performance of full repertory works. Adaptability, versatility, and fidelity to choreographic intention stressed. Offered as DANC 317 and DANC 417. Prereq: DANC 404.

DANC 418. Advanced Modern Dance Technique II. 1 - 3 Units.
Continuation of DANC 317/417. Offered as DANC 318 and DANC 418. Prereq: DANC 417.
DANC 424. Dance Production Resources. 3 Units.
An examination of dance production resources such as costumes, construction, lighting design, and management. Exercises include design, construction, and implementation to emphasize practical applications. Offered as DANC 324 and DANC 424.

DANC 426. Advanced Topics in Choreography. 3 Units.
Introduction and investigation of advanced topics in choreography including but not limited to dance and technology, directing ensemble dance, and dance and the narrative. This course work is explored in the format of in-studio practicum and lecture, discussion, and peer and instructor review of student generated work. Structured studies will be developed under instructor supervision; students will be required to dedicate time and energy in the studio outside of class meetings to develop choreography studies for in-class presentation and review. Prereq: DANC 345 and DANC 415 and DANC 416.

DANC 445. Kinesiology for Dance. 3 Units.
Seminar and laboratory for assessment of kinesiological and biomechanical principles as related to dance. Assessment of current research will be implemented to affect cross-training protocols. Offered as DANC 345 and DANC 445.

DANC 446. Topics in Dance Medicine, Science, and Wellness. 1 - 3 Units.
Review and application of continually emerging information from the fields of Dance Medicine and Science that impacts general dancer health and the care and prevention and treatment of dance specific injuries. Participation in the Dancer Wellness Program is encouraged to facilitate continued application of principles developed in DANC 345. Offered as DANC 346 and DANC 446.

DANC 447. Dancer Wellness Research. 1 - 6 Units.
This course is designed to promote research interests for those students who have had an introduction to the field of Dancer Wellness through their other coursework and/or participation in the Dancer Wellness Program annual screening and summary profiles. Prereq: DANC 446.

DANC 445. History of Modern Dance. 3 Units.
Origin and development of modern dance in its historical context.

DANC 460. Ballet Technique for Modern Dance Students I. 1 - 3 Units.
Ballet Technique for Dancers will focus on developing the ballet skills required of the Modern Dance major. The technical level of the class will range from intermediate to advanced where applicable in barre work as well as center. Offered as DANC 360 and DANC 460.

DANC 461. Ballet Technique for Modern Dance Students II. 1 - 3 Units.
Ballet Technique for Dancers will focus on developing the ballet skills required of the Modern Dance major. The technical level of the class will range from intermediate to advanced where applicable in barre work as well as center. Offered as DANC 361 and DANC 461. Prereq: DANC 460.

DANC 485. Rehearsal, Performance and Production. 1 - 6 Units.
(See DANC 385.)

DANC 505. Music Resources for Modern Dance. 3 Units.
Resources in the various periods and styles of music for the dancer/choreographer. Study of the choreographic use of music.

DANC 509. Introduction to Performance Theory. 1 - 3 Units.
This independent study oriented course is designed to acquaint the dance student with the major theoretical writings and practices of performance theory. Areas of exploration may include anthropological, mythological, psychological, and cultural sources of art, performance, and the creative impulse.

DANC 535. Modern Dance Pedagogy. 3 Units.
The study and investigation of the approaches and methods of teaching modern dance. Detailed study is made of kinesthetic, oral, and creative factors in teaching dance. Opportunity to assist and teach under supervision. Offered as DANC 335 and DANC 535.

DANC 601. Special Projects. 1 - 3 Units.
(Credit as arranged.)

DANC 610. Professional Internship. 1 - 4 Units.
Involvement in intensive internships with professional dance companies, private studios, festivals, workshops or clinicals to bridge the academic and professional lives. Internships may be scheduled for varying lengths of time.

DANC 640. M.F.A. Thesis Production I. 3 Units.
Preproduction conception in area of specialization researched and documented under appointed advisement, in accord with production syllabus, and subcommittee approval.

DANC 641. M.F.A. Thesis Production II. 3 Units.
Production implementation, post production evaluation/defense, and advisory assessment.

DANC 644. M.A. Project. 1 - 12 Units.
Research and development of a Master of Arts project in Dance.

Department of Earth, Environmental, and Planetary Sciences

112 A. W. Smith Building
http://eeps.case.edu/
Phone: Phone: 216.368.3690; Fax: Fax: 216.368.3691
James Van Orman, Department Chair
jav12@case.edu

The earth, environmental, and planetary sciences encompass a wide range of inquiries into the physical, chemical, and biological processes that shape the earth and the planets. Application of these inquiries to understanding a planet’s evolution through time is a unique attribute of geological investigations. Knowledge of the past and present reveals the constraints of our environment and serves as a guide for the future.

In recent years, significant advances have been made in the understanding of Earth’s interior, the nature of surface and near-surface processes, the history of the Earth’s climate, the ecology of living and ancient organisms, and the comparative geology of other planets. Geological knowledge is fundamental to resource conservation, land use planning and other environmental concerns.

Department faculty have active research programs to investigate planet formation and evolution, and Earth and environmental history. The department offers degree programs leading to the Bachelor of Arts (BA) and Bachelor of Science (BS) in geological sciences, BA in environmental geology, BA in environmental studies, Master of Science (MS), and Doctor of Philosophy (PhD). The Environmental Studies Program (p. 340) is described elsewhere in this bulletin.

Undergraduate Programs

Majors

Students in earth, environmental, and planetary sciences obtain a solid background in basic science and mathematics as well as intensive training in the major. In addition, because of the wide variety of ways in which geologic knowledge can be applied, all students are encouraged...
to take electives in subjects appropriate to their personal objectives, which may range from the engineering applications of geology to the socioeconomic and legal systems bearing on environmental issues. The undergraduate programs stress practical experience and fieldwork as well as classroom study. The environmental geology major combines courses in geological sciences with courses in basic and applied sciences to provide students with an understanding of environmental problems, with employable skills, and with a background for graduate study or professional school.

All students participate in a three-semester Senior Project sequence in which they propose a research project, conduct the research, write a thesis, and present it to the department.

**Geological Sciences Major**

**Required courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPS 110</td>
<td>Physical Geology</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 115</td>
<td>Introduction to Oceanography</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 119</td>
<td>Geology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EEPS 210</td>
<td>Earth History, Time, Tectonics, Climate, and Life</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 301</td>
<td>Stratigraphy and Sedimentation</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 315</td>
<td>Structural Geology and Geodynamics</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 317</td>
<td>Introduction to Field Methods</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 341</td>
<td>Mineralogy</td>
<td>4</td>
</tr>
<tr>
<td>EEPS 344</td>
<td>Igneous and Metamorphic Petrology</td>
<td>4</td>
</tr>
<tr>
<td>EEPS 360</td>
<td>Summer Field Camp</td>
<td>6</td>
</tr>
<tr>
<td>EEPS 390</td>
<td>Introduction to Geological Research</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 391</td>
<td>Senior Project</td>
<td>2</td>
</tr>
<tr>
<td>EEPS 392</td>
<td>Professional Presentation</td>
<td>2</td>
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<tr>
<td></td>
<td>Nine hours of EEPS electives (at least two of these courses must be at the 200 level or higher)</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Additional Required Courses</td>
<td></td>
</tr>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td></td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td></td>
</tr>
<tr>
<td>or MATH 124</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td></td>
</tr>
<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
<td></td>
</tr>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td></td>
</tr>
<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units** 70

EEPS 360 Summer Field Camp provides comprehensive field training in the summer between the junior and senior years (this course necessitates transfer credit, which must be approved by the department).

**Environmental Geology Major**

**Required courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPS 110</td>
<td>Physical Geology</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 119</td>
<td>Geology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EEPS 210</td>
<td>Earth History, Time, Tectonics, Climate, and Life</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 220</td>
<td>Environmental Geology</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 303</td>
<td>Environmental Law</td>
<td>3</td>
</tr>
<tr>
<td>or EEPS 202</td>
<td>Global Environmental Problems</td>
<td></td>
</tr>
<tr>
<td>EEPS 305</td>
<td>Geomorphology and Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 317</td>
<td>Introduction to Field Methods</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 321</td>
<td>Hydrogeology</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 390</td>
<td>Introduction to Geological Research</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 391</td>
<td>Senior Project</td>
<td>2</td>
</tr>
<tr>
<td>EEPS 392</td>
<td>Professional Presentation</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nine hours of EEPS electives (three additional courses at the 200 level or higher which relate to the science or societal implications of environmental concerns. Must be approved by department advisor.)</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Additional Required Courses</td>
<td></td>
</tr>
<tr>
<td>BIOL 114</td>
<td>Principles of Biology</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>ESTD 101</td>
<td>Introduction to Environmental Thinking</td>
<td>3</td>
</tr>
<tr>
<td>STAT 201</td>
<td>Basic Statistics for Social and Life Sciences</td>
<td>3</td>
</tr>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td></td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
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</tr>
<tr>
<td>or MATH 122</td>
<td>Calculus for Science and Engineering II</td>
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</tr>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td></td>
</tr>
<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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</tr>
</tbody>
</table>

**Total Units** 67

In the above majors, the student and his or her advisor will design the remainder of the curriculum based on individual interests, in accordance with departmental and college requirements. Through the Integrated Graduate Studies Program (p. 1078), students may earn a bachelor’s and a master’s degree in five years. Special programs, such as interdisciplinary majors, also may be arranged.

**Minor**

Students may complete a minor in geological sciences by taking at least 15 hours of coursework.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPS 119</td>
<td>Geology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Three of the following courses:</td>
<td>9</td>
</tr>
</tbody>
</table>
Graduate Programs
Graduate programs leading to the Master of Science and Doctor of Philosophy degrees are offered. Both programs are flexible so as to meet the needs of the individual student. General areas of study include aquatic systems, aquatic and groundwater chemistry, environmental geochemistry, benthic ecology, biostratigraphy and paleontology, environmental and urban geology, geomorphology, limnology, paleoclimatology, petrology, sedimentary geochemistry, sedimentation and stratigraphy, stable isotope studies, meteoritics, planetary materials, geodynamics of planetary interiors, and planetary geology. More specific information is available from the departmental office, the departmental Web page, and the Office of Admission of the School of Graduate Studies.

Facilities
The department’s research facilities include thin sectioning and mineral separation facilities; laboratories for chemical analysis of water, including an ion chromatograph, colorimetric spectrometer, atomic absorption spectrophotometer, electrochemistry equipment, and an environmental glove box; alpha and gamma spectroscopic facilities for analysis of environmental nuclides; equipment for studying animal-sediment relations, including a scanning gamma spectrometer; scanning electron microscope; electron microprobe; chemical reactors and a diamond anvil press for high-temperature and high-pressure geochemical experiments; and high-speed computing equipment.

Also housed in the department are laboratories for paleontological and micropaleontological investigations and for work in ecology and sedimentology. A well-field owned by the university is available for groundwater sampling and analysis.

The department also contains a wide range of other equipment, such as reflected and transmitted light microscopes, fluid inclusion microscope, cathodoluminescence microscope, submicron and clay-silt-sand particle size analyzers, high magnetic field mineral separator, X-ray diffractometer, and field equipment for groundwater and geophysical work, including resistivity meter, seismic refraction instrument, ground conductivity meter, magnetometer, and gravimeter and field equipment for soil and sediment sampling.

Department Faculty
James A. Van Orman, PhD
(Massachusetts Institute of Technology)
Professor and Chair
Geochemistry

Ralph P. Harvey, PhD
(University of Pittsburgh)
Professor
Planetary geology

Steven A. Hauck, II, PhD
(Washington University in St. Louis)
Professor
Geodynamics

Zhicheng Jing, PhD
(Yale University)
Assistant Professor
Mineral physics

Peter L. McCall, PhD, JD
(Yale University)
Professor; Director, Environmental Studies Program
Benthic ecology; paleoecology

Beverly Z. Saylor, PhD
(Massachusetts Institute of Technology)
Associate Professor
Sedimentary geology

Peter J. Whiting, PhD
(University of California, Berkeley)
Professor and Associate Dean
Geomorphology; surface water hydrology; environmental geology

Adjunct Faculty
Mulugeta Alene Araya, PhD
(University of Turin/University of Genoa)
Adjunct Associate Professor
Structural geology

Andrew Dombard, PhD
(Washington University in St. Louis)
Adjunct Associate Professor; University of Illinois-Chicago
Planetary geophysics

Joseph Hannibal, PhD
(Kent State University)
Adjunct Associate Professor; Cleveland Museum of Natural History
Invertebrate paleontology

David Saja, PhD
(University of Pennsylvania)
Adjunct Assistant Professor; Cleveland Museum of Natural History
Mineralogy

Emeritus
Gerald Matisoff, PhD
(Johns Hopkins University)
Professor
Sedimentary and environmental geochemistry

Samuel M. Savin, PhD
(California Institute of Technology)
Jesse Earl Hyde Professor Emeritus of Geological Sciences and Dean
Emeritus, College of Arts and Sciences
Isotope geochemistry
Francis Stehli, PhD  
(Columbia University)  
Professor Emeritus  
Paleontology and stratigraphy

Courses

EEPS 201. The Earth and Planets. 3 Units.  
An examination of the geological processes that have shaped the planets and moons of the inner solar system, focusing on those with relevance to our own planet Earth. Following an introduction to the fundamentals of planetary geology, lectures and exercises will explore how the inner planets (the asteroids, Mercury, Venus, Earth, the Moon, and Mars) exhibit the effects of planetary differentiation, impact cratering, volcanic activity, tectonics, climate, and interactions with life.

EEPS 110. Physical Geology. 3 Units.  
Introduction to geologic processes and materials that shape the world we live in. Hydrologic cycle and evolution of landscapes. Earthquakes, volcanoes, plate tectonics, and geologic resources. Students desiring laboratory experience should enroll in EEPS 119 concurrently.

EEPS 115. Introduction to Oceanography. 3 Units.  
The sciences of oceanography. Physical, chemical, biological, and geologic features and processes of the oceans. Differences and similarities between the oceans and large lakes including the Great Lakes. Required: Sunday field trip.

EEPS 117. Weather and Climate. 3 Units.  
Introduction to the study of weather and climate. Covers the basics of meteorology, climate zones, the hydrologic cycle, and weather prediction. Lectures address timely topics including greenhouse warming, past global climates, and recent advances in meteorology.

EEPS 119. Geology Laboratory. 1 Unit.  
Principles and techniques common to the geological sciences including rock and mineral identification, map interpretation, land form analysis, application of geological information to engineering works, and more. One three-hour laboratory or field trip weekly. Recommended preparation: EEPS 110.

EEPS 201. Formation and Evolution of a Habitable Planet. 3 Units.  
This course will provide an introduction to the formation and evolution of Earth with an emphasis on how our habitable planet has originated, developed, and sustained conditions suitable for life from a planetary science perspective. Topics include the Big Bang and formation of elements, formation of minerals and organic molecules, formation of the Solar System and planets, formation and differentiation of Earth’s interior, plate tectonics and internal circulation, interactions between interior, atmosphere, and oceans, climate regulation, co-evolution of life and planet, and habitability of other planets in the Solar System and in the universe.

EEPS 202. Global Environmental Problems. 3 Units.  
Global Environmental Problems is a course designed to provide students with an understanding of, and an appreciation for, human-influenced environmental changes that are global in scope. Accordingly, much of the material will focus on the nature and structure of natural global systems, how and where in those systems human influences occur, and will delve deeply into a few particular problems and solutions of current interest, such as population growth, climate change, ozone depletion, and fisheries, from a variety of viewpoints. Offered as ESTD 202 and EEPS 202.

EEPS 210. Earth History: Time, Tectonics, Climate, and Life. 3 Units.  
The discovery and measurement of deep time, tectonic cycles, and geochemical cycles. The origin of life, major fossil groups and their evolution over time. Earth systems history: Major tectonic, ecologic, and climatic events in the last 4.5 billion years.

EEPS 215. Climate Crises in Earth History. 3 Units.  
The past century has seen three great revolutions in our understanding of how the earth works: a revolution our understanding of geologic time, construction of the tectonic cycle that creates continents and oceans, and most recently, the ability to trace using isotopes global geochemical cycles. One of these, the carbon cycle, is intimately tied to climate change. We now know there have been a handful of climate crises in earth history—at least five—during which the planet experienced large scale changes in a short time, and we live now in the midst of another. We will examine the large-scale workings of the earth system, how the carbon cycle interacts with climate on time scales from millions of years to millennia to decades, and get an accessible overview of what we know about ongoing climate change and its current and future impacts. No prior knowledge of geology is assumed, and the course is suitable for non-majors, though we will encounter a few equations, some graphs, and some very simple computer models.

EEPS 220. Environmental Geology. 3 Units.  

EEPS 225. Evolution. 3 Units.  
Multidisciplinary study of the course and processes of organic evolution provides a broad understanding of the evolution of structural and functional diversity, the relationships among organisms and their environments, and the phylogenetic relationships among major groups of organisms. Topics include the genetic basis of micro- and macro-evolutionary change, the concept of adaptation, natural selection, population dynamics, theories of species formation, principles of phylogenetic inference, biogeography, evolutionary rates, evolutionary convergence, homology, Darwinian medicine, and conceptual and philosphic issues in evolutionary theory. Offered as ANTH 225, BIOL 225, EEPS 225, HSTY 225, and PHIL 225.

EEPS 301. Stratigraphy and Sedimentation. 3 Units.  
Formation, distribution, and composition of sediments and sedimentary rocks. Modern depositional environments and their ancient analogues; principles of stratigraphic and biostratigraphic correlation. Two lectures and one laboratory per week. Offered as EEPS 301 and EEPS 401.

EEPS 303. Environmental Law. 3 Units.  
Introduction to treatment of environmental issues in legal proceedings. Sources of environmental law, legal procedure, common law remedies (toxic torts and human health, nuisance, contract law), statutes and regulations, endangered species, public lands, toxics regulation, nuclear power, coal. The course employs the case method of reading and recitation of appellate judicial opinions. We read both classic cases in environmental law as well as current controversies. Offered as ESTD 303 and EEPS 303.

EEPS 305. Geomorphology and Remote Sensing. 3 Units.  
Recognition and interpretation of land forms and their significance in revealing present and past geologic processes. Introduction to acquisition and analysis of data through aerial photography and satellite imagery. Two lectures and one laboratory weekly. Recommended preparation: EEPS 110 and EEPS 119. Offered as EEPS 305 and EEPS 405.
EEPS 307. Evolutionary Biology and Paleobiology of Invertebrates. 3 Units.
Important events in the evolution of invertebrate life; structure, function, and phylogeny of major invertebrate groups.

EEPS 315. Structural Geology and Geodynamics. 3 Units.
Theoretical analysis of deformation in earth materials, with illustrations of deformational styles in various tectonic settings and the dynamics of the Earth’s interior. Recommended preparation: EEPS 110. Offered as EEPS 315 and EEPS 415.

EEPS 317. Introduction to Field Methods. 3 Units.
Practice in field procedures, recognition and testing of hypotheses in the field, field mapping and analysis of sedimentary, igneous, and metamorphic rocks in deformed and tectonically active settings. Weekly meeting plus spring break field trip. Students required to pay partial cost of meals, lodging, and travel. Offered as EEPS 317 and EEPS 417. Prereq: EEPS 119.

EEPS 321. Hydrogeology. 3 Units.
Basic and applied concepts pertaining to the occurrence and movement of groundwater. Definitions, basic equations, applications to a variety of geologic settings, wells. Requires one Saturday field trip to make field measurements, collect and analyze data, and prepare a report. Offered as EEPS 321 and EEPS 421.

EEPS 330. Geophysical Field Methods and Laboratory. 4 Units.
Use of seismic refraction and reflection, gravity, electrical, magnetic, and electromagnetic methods to infer the earth's structure and composition. Application of inverse theory to estimate model parameters. Requires students to make field measurements, analyze data, and prepare a report. Includes several required Saturday field trips. Offered as EEPS 330 and EEPS 430.

EEPS 336. Aquatic Chemistry. 4 Units.
Chemical equilibria occurring in natural waters. Quantitative methods of describing acid-base, metal ion/ligand, precipitation/dissolution, and oxidation/reduction reactions. Geochemical cycling of trace metals and nutrients. Offered as EEPS 336 and EEPS 436.

EEPS 340. Earth and Planetary Interiors. 3 Units.
Quantitative introduction to the composition, structure, dynamics, and evolution of Earth and other planets using principles of geophysics and geochemistry. Planetary formation and differentiation, composition and structure of Earth and planets, heat generation and heat flow, mantle convection and plate tectonics, planetary magnetism and core dynamics, chemical evolution of Earth and planets, extrasolar planets and super Earths. This course will be offered to both undergraduate students and graduates. In addition to the requirements for undergraduate students, graduate students will be asked to work on a small course project relevant to the subject of the course and submit a term paper based on this project by the end of semester. Offered as EEPS 340 and EEPS 440. Prereq: MATH 122 or MATH 126.

EEPS 341. Mineralogy. 4 Units.
Crystallography, hand specimen mineralogy and petrology, principles of crystal structure and crystal chemistry, elementary thermodynamics and phase diagrams, and an introduction to the petrographic microscope. Three lectures and one three-hour laboratory weekly. Recommended preparation: EEPS 119.

EEPS 344. Igneous and Metamorphic Petrology. 4 Units.
Composition, classification, and genesis of igneous and metamorphic rocks, emphasizing physical and chemical principles governing their origin. Laboratory study of rocks in thin section. Two lectures and two three-hour laboratories weekly. Prereq: EEPS 341.

EEPS 345. Planetary Materials. 1 - 3 Units.
An introduction to the materials that make up the solid matter of the solar system. Student presentations will review our current understanding of accessible primitive materials such as meteorites, cosmic dust, lunar and ancient terrestrial rocks, and their relationship to modern natural materials and solar system processes. Offered as EEPS 345 and EEPS 445.

EEPS 349. Geological Problems. 1 - 3 Units.
Special work arranged according to the qualifications of the student.

EEPS 350. Geochemistry. 3 Units.
Introduction to geochemistry. Properties of the elements, elemental and isotopic fractionation, element transport, geochemical systems, geochronology, mineral reactions, the solid Earth, Earth in the solar system. A quantitative approach to modeling geochemical processes will be emphasized throughout. Offered as EEPS 350 and EEPS 450.

EEPS 360. Summer Field Camp. 6 Units.
Six-week course in geologic field methods and mapping. Not offered at CWRU; must be taken at another college or university. Credits will be transferred.

EEPS 367. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic in interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467. Prereq: EEPS 225 or equivalent.

EEPS 390. Introduction to Geological Research. 3 Units.
Examination of factors in the selection, design, and conduct of research projects and in the analysis and interpretation of research results. Consideration of ethical issues in scientific research. Development of a written research proposal and oral presentation of proposed research. Consultations with department faculty in development of research proposal. Research initiation. Offered as EEPS 390 and EEPS 490. Counts as SAGES Departmental Seminar.

EEPS 391. Senior Project. 2 Units.
Research project required of all department majors, based on formal project proposals presented to department faculty. Proposals may be submitted prior to the semester in which EEPS 391 is taken. Grading based on project progress presentation that will include a statement of the problem, a literature review, a description of their field/lab work and presentation of their data collected to date. This course is the first of a 2 semester Senior Capstone (EEPS 391, 392) sequence. Recommended preparation: EEPS 390. Counts as SAGES Senior Capstone.

EEPS 392. Professional Presentation. 2 Units.
Preparation and presentation of final written and oral reports on individual Senior Projects. Class meetings focus on group discussion of problem areas in analysis and interpretation of project results, and in styles of writing poster and oral presentation as demonstrated by practice examples. This course is the second in a two-course (EEPS 391, 392) Senior Capstone sequence. Counts as SAGES Senior Capstone. Prereq: EEPS 390 and EEPS 391. Or Coreq: EEPS 390.
EEPS 396. Undergraduate Research in Evolutionary Biology. 3 Units.
Students propose and conduct guided research on an aspect of evolutionary biology. The research will be sponsored and supervised by a member of the CASE faculty or other qualified professional. A written report must be submitted to the Evolutionary Biology Steering Committee before credit is granted. Offered as ANTH 396, BIOL 396, EEPS 396, and PHIL 396.

EEPS 401. Stratigraphy and Sedimentation. 3 Units.
Formation, distribution, and composition of sediments and sedimentary rocks. Modern depositional environments and their ancient analogues; principles of stratigraphic and biostratigraphic correlation. Two lectures and one laboratory per week. Offered as EEPS 301 and EEPS 401.

EEPS 405. Geomorphology and Remote Sensing. 3 Units.
Recognition and interpretation of land forms and their significance in revealing present and past geologic processes. Introduction to acquisition and analysis of data through aerial photography and satellite imagery. Two lectures and one laboratory weekly. Recommended preparation: EEPS 110 and EEPS 119. Offered as EEPS 305 and EEPS 405.

EEPS 415. Structural Geology and Geodynamics. 3 Units.
Theoretical analysis of deformation in earth materials, with illustrations of deforming styles in various tectonic settings and the dynamics of the Earth's interior. Recommended preparation: EEPS 110. Offered as EEPS 315 and EEPS 415.

EEPS 417. Introduction to Field Methods. 3 Units.
Practice in field procedures, recognition and testing of hypotheses in the field, field mapping and analysis of sedimentary, igneous, and metamorphic rocks deformed in deformed and tectonically active settings. Weekly meeting plus Spring break field trip. Students required to pay partial cost of meals, lodging, and travel. Offered as EEPS 317 and EEPS 417.

EEPS 421. Hydrogeology. 3 Units.
Basic and applied concepts pertaining to the occurrence and movement of groundwater. Definitions, basic equations, applications to a variety of geologic settings, wells. Requires one Saturday field trip to make field measurements, collect and analyze data, and prepare a report. Offered as EEPS 321 and EEPS 421.

EEPS 430. Geophysical Field Methods and Laboratory. 4 Units.
Use of seismic refraction and reflection, gravity, electrical, magnetic, and electromagnetic methods to infer the earth's structure and composition. Application of inverse theory to estimate model parameters. Requires students to make field measurements, analyze data, and prepare a report. Includes several required Saturday field trips. Offered as EEPS 330 and EEPS 430.

EEPS 436. Aquatic Chemistry. 4 Units.
Chemical equilibria occurring in natural waters. Quantitative methods of describing acid-base, metal ion/ligand, precipitation/dissolution, and oxidation/reduction reactions. Geochemical cycling of trace metals and nutrients. Offered as EEPS 336 and EEPS 436.

EEPS 437. Chemistry of Natural Waters. 3 Units.
Advanced topics in aquatic chemistry. Thermodynamics models for ion/ligand speciation in natural waters; origin and composition of seawater, chemical and mineralogical sequence during evaporation, chemical weathering, groundwater and river water chemistry, chemical cycling and a global mass balances; perturbations on natural systems by man. Predictive capabilities of box models.

EEPS 440. Earth and Planetary Interiors. 3 Units.
Quantitative introduction to the composition, structure, dynamics, and evolution of Earth and other planets using principles of geophysics and geochemistry. Planetary formation and differentiation, composition and structure of Earth and planets, heat generation and heat flow, mantle convection and plate tectonics, planetary magnetism and core dynamics, chemical evolution of Earth and planets, extrasolar planets and super Earths. This course will be offered to both undergraduate students and graduates. In addition to the requirements for undergraduate students, graduate students will be asked to work on a small course project relevant to the subject of the course and submit a term paper based on this project by the end of semester. Offered as EEPS 340 and EEPS 440. Prereq: MATH 122 or MATH 126.

EEPS 445. Planetary Materials. 1 - 3 Units.
An introduction to the materials that make up the solid matter of the solar system. Student presentations will review our current understanding of accessable primitive materials such as meteorites, cosmic dust, lunar and ancient terrestrial rocks, and their relationship to modern natural materials and solar system processes. Offered as EEPS 345 and EEPS 445.

EEPS 450. Geochemistry. 3 Units.
Introduction to geochemistry. Properties of the elements, elemental and isotopic fractionation, element transport, geochemical systems, geochronology, mineral reactions, the solid Earth, Earth in the solar system. A quantitative approach to modeling geochemical processes will be emphasized throughout. Offered as EEPS 350 and EEPS 450.

EEPS 467. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTHR/EEPS/PHIL/PHOL 467/BIOI 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467.

EEPS 490. Introduction to Geological Research. 3 Units.
Examination of factors in the selection, design, and conduct of research projects and in the analysis and interpretation of research results. Consideration of ethical issues in scientific research. Development of a written research proposal and oral presentation of proposed research. Consultations with department faculty in development of research proposal. Research initiation. Offered as EEPS 390 and EEPS 490. Counts as SAGES Departmental Seminar.

EEPS 506. Seminar in Geophysics. 1 - 3 Units.
Selected topics in geophysics: advanced research issues, classical papers, current state of the field, advanced techniques. Course content will vary depending on interests of students and faculty.

EEPS 509. Seminar: Graduate Research. 1 Unit.

EEPS 511. Special Readings in Geology. 1 - 6 Units.
Detailed study of a selected topic in geology under the guidance of a faculty member.

EEPS 512. Special Readings in Geology. 1 - 6 Units.
Detailed study of a selected topic in geology under the guidance of a faculty member.

EEPS 601. Special Problems and Research. 1 - 18 Units.
(Credit as arranged.)

EEPS 651. Thesis M.S.. 1 - 18 Units.
(Credit as arranged.)
Department of Economics

The College of Arts and Sciences awards the Bachelor of Arts degree in economics. The required courses for the major and minor are offered by the Department of Economics in the Weatherhead School of Management.

Bachelor of Arts (BA) in Economics
(College of Arts and Sciences)

The BA in Economics is a 120-credit-hour, structured program in which students learn to analyze problems of resource allocation and decision making, and to understand the influence of these factors on economies and societies.

Our highly regarded degree attracts some of the best students on campus. Students have the opportunity to assist Weatherhead faculty in their research activities and to participate in independent research projects.

General Degree Requirements

Students are required to complete the Arts and Sciences General Education Requirements (p. 38).

Students who desire a Secondary Major in Economics should consult with a Weatherhead academic advisor.

Major Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td></td>
</tr>
<tr>
<td>ECON 102</td>
<td>Principles of Microeconomics</td>
<td>3</td>
</tr>
<tr>
<td>ECON 103</td>
<td>Principles of Macroeconomics</td>
<td>3</td>
</tr>
<tr>
<td>ECON 307</td>
<td>Intermediate Macro Theory</td>
<td>3</td>
</tr>
<tr>
<td>ECON 308</td>
<td>Intermediate Micro Theory</td>
<td>3</td>
</tr>
<tr>
<td>or ECON 309</td>
<td>Intermediate Micro Theory: Calculus-Based</td>
<td></td>
</tr>
<tr>
<td>OPRE 207</td>
<td>Statistics for Business and Management Science I</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 243</td>
<td>Statistical Theory with Application I</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
<td></td>
</tr>
<tr>
<td>ECON 326</td>
<td>Econometrics (Ideally, Econometrics should be taken by the junior year to enrich understanding of upper-level elective courses and to enable engagement in more sophisticated economic analysis.)</td>
<td>4</td>
</tr>
</tbody>
</table>

Elective courses (a minimum of five additional economics courses at the 200 or 300 level). ECON 398 Honors Research II does not count toward fulfilling this requirement.

Total Units 38

SAGES Senior Capstone Experience

The economics major does not require a capstone as part of the major. However, students need to complete a capstone as part of the SAGES requirement. The Economics Department offers the following courses for a capstone.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 398</td>
<td>Honors Research II</td>
<td>3</td>
</tr>
<tr>
<td>ECON 395</td>
<td>The Economy in the American Century</td>
<td>3</td>
</tr>
<tr>
<td>ECON 399</td>
<td>Individual Readings and Research (upon approval of Senior Capstone Coordinator)</td>
<td>3-6</td>
</tr>
</tbody>
</table>

For more information, contact Teresa Kabat (teresa.kabat@case.edu), department administrator, at 216.368.4110.

Department of English

106B Guilford House
www.case.edu/artscli/engl
Phone: 216.368.1508; Fax: 216.368.4367
Christopher Flint, Department Chair
christopher.flint@case.edu

The Department of English offers courses of study leading to the Bachelor of Arts, Master of Arts, and Doctor of Philosophy degrees. Included among the department’s offerings are literary and cultural studies, linguistics, film, journalism and new media, creative writing, visual rhetoric, rhetoric, and professional writing.

Combining the intellectual resources of a major research university with a scale and set of values more typical of a liberal arts college, the department puts great stress on class discussion, individual conferences or tutorials, and other opportunities for students and faculty to work closely together. Likewise, the curriculum is deliberately flexible to respond to student needs and interests and to encourage close cooperation with the faculty in planning a course of study.

A major in English prepares one for various sorts of careers. Three paths are common:

• English leads readily to careers that put a premium on writing skills and on the ability to analyze complex human situations. In addition to the fields that have often been of first interest to English majors (writing and publishing, journalism, advertising, the film industry, public relations, and teaching), significant opportunities exist in the corporate world, in government, and in nonprofit organizations such as those devoted to social service, the environment, or the arts.
• The BA in English is usually essential to anyone expecting to do graduate work in English or to pursue a career as a teacher or a scholar in the field.
• The BA in English traditionally has been an important steppingstone to success in professional school, and many of our English majors choose this path. A significant number go on to law school, many to medical or business school, and some to nursing, journalism, social work, or library school, as well as directly into the business world.

Facilities

In Bellflower Hall, Writers House augments the English Department’s mission through public lectures, workshops, community projects, and the Writing Resource Center. In addition to manuscript and rare-book holdings in the Special Collections Division, Kelvin Smith Library has strengths in Renaissance literature; 18th-, 19th-, and 20th-century English literature; and American literature. The library also houses an outstanding collection of several thousand films and other audiovisual materials,
supported in part by English department endowment funds. In Strosacker Auditorium, the Film Society maintains facilities capable of projecting 35 mm and 16 mm films. In the library's Freedman Center for Digital Scholarship, students have access to video cameras, state-of-the-art digital editing software, and stations where they can view audiovisual materials from the library collection.

## Undergraduate Programs

### Major

The major in English includes two tracks. The primary track consists of at least 33 semester hours in English above the 100 level (including 15 hours at the 300 level or above). The required courses are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 300</td>
<td>English Literature to 1800</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 302</td>
<td>English Literature since 1800</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 308</td>
<td>American Literature</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 380</td>
<td>Departmental Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

A capstone course designated with a C, as in ENGL 309C or ENGL 324C, fulfills the English major capstone requirement as well as the SAGES capstone requirement.

You'll also need to take one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 310</td>
<td>History of the English Language</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 312</td>
<td>Chaucer</td>
<td></td>
</tr>
<tr>
<td>ENGL 320</td>
<td>Renaissance Literature</td>
<td></td>
</tr>
<tr>
<td>ENGL 323</td>
<td>Milton</td>
<td></td>
</tr>
<tr>
<td>ENGL 324</td>
<td>Shakespeare: Histories and Tragedies</td>
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<tr>
<td>ENGL 325</td>
<td>Shakespeare: Comedies and Romances</td>
<td></td>
</tr>
<tr>
<td>ENGL 327</td>
<td>Eighteenth-Century Literature</td>
<td></td>
</tr>
<tr>
<td>ENGL 328</td>
<td>Studies in the Eighteenth Century</td>
<td></td>
</tr>
<tr>
<td>ENGL 329</td>
<td>English Literature, 1780-1837</td>
<td></td>
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</tbody>
</table>

Fifteen additional hours of English courses, at least 3 of which must be at the 300 level: 15

Because of the flexibility of departmental requirements and the variety of career paths to which the major may lead, all students should confer frequently and closely with advisors. No courses outside the department are required for the major (although a language course is necessary for the Honors track—see below), but the department recommends courses in comparative literature, history, philosophy, history and criticism of the fine arts, theater, and literature in other languages. Students planning to go to graduate school are reminded of the importance of foreign language study.

Completion of the university composition requirement (ENGL 150 Expository Writing or SAGES First Seminar) is a prerequisite for most English courses at the 200 level and above.

### Departmental Honors

To qualify for honors, English majors must maintain a minimum GPA of 3.75 in English courses taken for honors and follow a track consisting of at least 36 hours above the 100 level, including the general requirements for the major (see above); ENGL 387 Literary and Critical Theory; at least 18 hours of approved electives in literary and cultural studies; and a course in a foreign language taught in the elected language at or above the 200 level or a course either in linguistics or in the history of the English language (the latter, however, cannot double count for the general pre-1800 requirement and for honors track language substitution). To be eligible, students must also complete their capstone requirement in a designated capstone course in English.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRCH 202</td>
<td>Intermediate French II</td>
<td>4</td>
</tr>
<tr>
<td>GREK 202</td>
<td>Introduction to Greek Poetry</td>
<td>3</td>
</tr>
<tr>
<td>GRMN 202</td>
<td>Intermediate German II</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 202</td>
<td>Intermediate Japanese II</td>
<td>4</td>
</tr>
<tr>
<td>LATN 202</td>
<td>Vergil</td>
<td>3</td>
</tr>
<tr>
<td>SPAN 202</td>
<td>Intermediate Spanish II</td>
<td>4</td>
</tr>
</tbody>
</table>

The award of honors requires a minimum GPA of 3.5 in courses taken for the honors program.

The department also offers other specialized options which follow.

### Teacher Licensure in Integrated Language Arts

The English department offers a special option for undergraduate students who wish to pursue an English major and a career in teaching. The Adolescent to Young Adult (AYA) Teacher Education Program in Integrated Language Arts prepares CWRU students to receive an Ohio Teaching License for grades 7-12. Students declare a second major in education—which involves 34 hours in education and practicum requirements—and complete a planned sequence of English content course work within the context of an English major. The program is designed to offer several unique features not found in other programs and to place students in mentored teaching situations throughout their teacher preparation career. This small, rigorous program is designed to capitalize on the strengths of CWRU's English department, its Teacher Education Program, and the relationships the university has built with area schools.

The subject area requirements for teacher licensure (42 credit hours) are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 204</td>
<td>Introduction to Journalism</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 300</td>
<td>English Literature to 1800</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 302</td>
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<tr>
<td>ENGL 308</td>
<td>American Literature</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 310</td>
<td>History of the English Language</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 324</td>
<td>Shakespeare: Histories and Tragedies</td>
<td>3</td>
</tr>
<tr>
<td>or ENGL 325</td>
<td>Shakespeare: Comedies and Romances</td>
<td></td>
</tr>
<tr>
<td>ENGL 368</td>
<td>Topics in Film</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 380</td>
<td>Departmental Seminar</td>
<td>3</td>
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One of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tr>
<td>ENGL 301</td>
<td>Linguistic Analysis</td>
<td>3</td>
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<tr>
<td>or ENGL 379</td>
<td>Topics in Language Studies</td>
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<td>or COSI 313</td>
<td>Language Development</td>
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Two of the following: 6

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<thead>
<tr>
<th>Course</th>
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<tr>
<td>ENGL 257B</td>
<td>Poetry</td>
<td>3</td>
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<tr>
<td>ENGL 270</td>
<td>Introduction to Gender Studies</td>
<td>3</td>
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<tr>
<td>ENGL 363H</td>
<td>African-American Literature</td>
<td>3</td>
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<tr>
<td>ENGL 365E</td>
<td>The Immigrant Experience</td>
<td>3</td>
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<tr>
<td>ENGL 365N</td>
<td>Topics in African-American Literature</td>
<td>3</td>
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<td>ENGL 365Q</td>
<td>Post-Colonial Literature</td>
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Recommended electives:

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<th>Course</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>ENGL 203</td>
<td>Introduction to Creative Writing</td>
<td>3</td>
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</table>
In addition, students submit a creative writing portfolio. 15 credit hours, which includes the following:

Requirements:

- Writing Workshop: Fiction
  - ENGL 213 Introduction to Fiction Writing

- Poetry
  - ENGL 304 Intermediate Writing Workshop: Poetry

- An approved elective course (up to 6 credits) 0-6

Integrated Graduate Studies

The Department of English participates in the Integrated Graduate Studies Program (p. 1078), which makes it possible to complete both a BA and an MA in English in about five years of full-time study. The department particularly recommends the program to qualified students who are interested in seeking admission to highly competitive professional schools or PhD programs. Interested students should note the general requirements and the admission procedures elsewhere in this bulletin.

Minors

Minor in English

The minor in English consists of at least 15 hours above the 100 level. Students who wish to minor in English arrange their sequence of courses in consultation with the department advisor. Minors are strongly advised to take ENGL 200 Literature in English early in the sequence. They should also keep in mind that the flexibility of the department’s requirements often makes it possible to take English as a second major.

Minor in Film Studies

Like the minor in English, the minor in Film Studies requires 15 hours:

- ENGL 367 Introduction to Film (It is recommended that students take this course first or as early in the sequence as possible.) 3

The remaining 12 credits can consist of any combination of the following:

- ENGL 368 Topics in Film (up to 12 credits) 3
- ENGL 368C Topics in Film Capstone (up to 3 credits) 3
- ENGL 316 Screenwriting (up to 3 credits) 3
- An approved elective course (up to 6 credits) 0-6

Minor in Creative Writing

The minor in creative writing requires 15 credit hours. Students will take courses in two genres—poetry and fiction—and will be required to have an intro/intermediate sequence in one of those genres (e.g., ENGL 213 Introduction to Fiction Writing and ENGL 303 Intermediate Writing Workshop: Fiction).

Requirements:

- 15 credit hours, which includes the following:
  - 9 credit hours in creative writing courses (at least 6 hours in one genre)
  - 6 credit hours in literature classes

For the literature requirement, students should take two 300-level classes; at least one of these classes should match their dominant genre.

These courses may be in other disciplines if cross-listed with English (e.g., World Literature). Up to six credits may count toward either the English major or another minor (but not both).

Concentration in Film

The film concentration requires that 9 of the 30 credits for the English major be approved film courses.

These 9 credits must include:

- ENGL 367 Introduction to Film 3
  (students are advised to take as early in the film sequence as possible.)

The remaining 6 credits can consist of any combination of the following:

- ENGL 368 Topics in Film (up to 6 credits) 3
- ENGL 368C Topics in Film Capstone 3
- ENGL 316 Screenwriting 3
- ENGL 309 Immersion Journalism/Multimedia Storytelling 3

Or an approved elective course*

* Many courses taught across the University can qualify as elective courses, and new ones are coming along all the time. Past courses that would qualify include Latin American Cinema, Black Religion and Film, The Hollywood Musical, Topics in German Cinema, Film Music, Jewish Image in Popular Culture, French Cinema, James Bond in Popular Culture, Classics in Film, and Folklore & Myth in Japanese Film.

Graduate Programs

The Department of English offers programs in American and English literature and language leading to the Master of Arts and Doctor of Philosophy degrees. At either the MA or PhD level, students may elect a project concentration in Writing History and Theory or a course work concentration in Creative Writing.

Candidates for graduate work in English should present an undergraduate major in English or a minimum of 18 semester hours of English (or its equivalent) beyond the freshman level. In some cases, students will be required to make up deficiencies without graduate credit. The department requires all candidates for admission to submit their scores on the aptitude sections of the Graduate Record Examination. Candidates are also required to submit a writing sample, consisting of at least 15 pages of academic writing.

A maximum of six semester hours of transfer credit will be accepted from another institution and applied toward the MA, provided they were earned in graduate-level courses, with the approval of the department and the dean of graduate studies. (PhD transfer credit is normally not granted.) Such courses must have been taken within five years of matriculation at Case Western Reserve University and passed with grades of B or better. The department accommodates part-time students in certain circumstances.

New and continuing graduate students are normally supported with graduate assistantships providing tuition remission and a living stipend. Assistantships are awarded by the dean on the recommendation of the department. Applicants to the PhD program with previous teaching
experience are preferred. All graduate assistants are required to take university- and department-level teacher training courses in their first semester of work at the university.

Teaching is viewed as an essential part of the education of graduate students aspiring to academic posts, and is required of all students working under assistantships. The department provides opportunities for graduate assistants to gain teaching experience in a variety of courses and in the Writing Resource Center.

### Department Faculty

Christopher Flint, PhD  
(University of Pennsylvania)  
**Professor and Chair**  
18th-century English literature; print culture

Michael Clune, PhD  
(Johns Hopkins University)  
**Professor**  
American literature; literature and science; poetry

Kimberly Emmons, PhD  
(University of Washington)  
**Associate Professor**  
Rhetoric; composition; gender and language; medical humanities

T. Kenneth Fountain, PhD  
(University of Minnesota)  
**Associate Professor; Director of Composition**  
Scientific and technical communication; visual culture; rhetorical theory

Sarah Gridley, MFA  
(University of Montana)  
**Associate Professor**  
Creative writing (poetry); feminist and eco-poetics

Mary Grimm, MA  
(Cleveland State University)  
**Associate Professor**  
Creative writing (fiction); contemporary literature; graphic novels

Megan Swihart Jewell, PhD  
(Duquesne University)  
**Instructor; Director, Writing Resource Center**  
American literature; writing studies; poetics

Kurt Koenigsberger, PhD  
(Vanderbilt University)  
**Associate Professor; Director of Graduate Studies; Associate Dean, College of Arts and Sciences**  
19th- and 20th-century British literature; postcolonial literature

William H. Marling, PhD  
(University of California, Santa Barbara)  
**Professor**  
American and world literature; modernism; popular culture

Erika Mae Olbricht, PhD  
(University of New Hampshire)  
**Instructor; SAGES Instructional Coordinator**  
16th- and 17th-century British literature and theatre; landscape studies

John M. Orlock, MFA  
(Pennsylvania State University)  
**Samuel B. and Virginia C. Knight Professor of Humanities; Director, Writers House**  
Playwriting; screenwriting

Martha Wilson Schaffer, JD, PhD  
(Bowling Green State University)  
**Instructor; Associate Director of Composition**  
Rhetoric; composition; writing assessment

James Sheeler, MA  
(University of Colorado)  
**Shirley Wormser Professor of Journalism and Media Writing; Director of Undergraduate Studies**  
Journalism

William R. Siebenschuh, PhD  
(University of California, Berkeley)  
**Oviatt Professor of English**  
18th- and 19th-century British literature; biography and autobiography

Robert Spadoni, PhD  
(University of Chicago)  
**Armington Professor; Associate Professor**  
Film studies

Thrity Umrigar, PhD  
(Kent State University)  
**Professor**  
Creative writing (fiction and memoir); journalism; African American literature

Maggie Vinter, PhD  
(Johns Hopkins University)  
**Associate Professor**  
16th- and 17th-century British literature; drama

Athena Vrettos, PhD  
(University of Pennsylvania)  
**Associate Professor**  
19th-century British literature; literature and medicine; literature and psychology; women’s and gender studies

Martha Woodmansee, PhD  
(Stanford University)  
**Professor**  
Literary theory; 18th- and 19th-century comparative literature; copyright

### Adjunct Faculty

Michael Householder, PhD  
(University of California, Irvine)  
**Adjunct Instructor**  
Early American literature; literary theory; bioethics
Courses

**ENGL 146. Tools, Not Rules: English Grammar for Writers. 3 Units.**
This course provides an introduction to English grammar in context for academic writers. It focuses on the study of language in use, including parts of speech, sentence grammar, paragraph structure, and text cohesion. This course is specifically designed for multilingual students, but native speakers of English may take the course with the approval of the instructor.

**ENGL 148. Introduction to Composition. 3 Units.**
Practice and training in various modes and genres of writing. Undergraduate CIM students placed into ENGL 148 must complete the course with a grade of C or higher in order to enroll in ENGL 150.

**ENGL 149. Emerging Writers Studio. 3 Units.**
Introduction to the academic writing process in an intensive seminar and workshop environment. Course includes training and practice in prewriting, drafting, revising and editing.

**ENGL 150. Expository Writing. 3 Units.**
Substantial training and practice in academic writing.

**ENGL 155. Introduction to Rhetoric and Public Speaking. 3 Units.**
This course will focus on the theories of rhetoric, the work of developing and preparing a speech and on the art and skill of delivering various kinds of oral presentations. The assignments will: a) Introduce students to the traditions, theories and core principles of public speaking, from Aristotle’s Rhetoric to Cicero to Kenneth Burke. b) Engage them in the five-part “canon of rhetoric” for developing speeches. c) Give them opportunities to develop and deliver several different types of classic speeches, both as a speaker and as a speechwriter.

**ENGL 180. Writing Tutorial. 1 Unit.**
Substantial scheduled tutorial work in writing.

**ENGL 181. Academic Skills Tutorial. 1 Unit.**
Substantial tutorial work on academic skills such as: reading and vocabulary development, academic interactions and resources, critical thinking, time management, and/or study strategies. Students may work individually with instructor or in small groups. The course may be repeated, but only one semester-hour will count towards the degree.

**ENGL 183. Academic Writing Studio. 1 Unit.**
Practice and training in various aspects of academic writing in a small group workshop environment. Please note: only one semester hour of ENGL 183 will count toward a degree, but the course may be repeated.

**ENGL 184. Research Writing Studio. 1 Unit.**
Practice and training in various aspects of research in a small-group workshop environment. Offered concurrently with University Seminar, provides supplementary instruction to help students meet University Seminar writing objectives. Please note: only two semester hours of ENGL 184 will count towards a degree.

**ENGL 186. Writing Workshop for Researchers. 2 Units.**
Individualized writing workshop/tutorial for graduate students, faculty, and staff. Includes small group workshops and individualized instruction in genres and forms of academic and research writing.

**ENGL 200. Literature in English. 3 Units.**
This course introduces students to the reading of literature in the English language. Through close attention to the practice of reading, students are invited to consider some of the characteristic forms and functions imaginative literature has taken, together with some of the changes that have taken place in what and how readers read. Recommended preparation: Concurrent enrollment in ENGL 150 or USFS 100.

**ENGL 203. Introduction to Creative Writing. 3 Units.**
A course exploring basic issues and techniques of writing narrative prose and verse through exercises, analysis, and experiment. For students who wish to try their abilities across a spectrum of genres.

**ENGL 204. Introduction to Journalism. 3 Units.**
Students will learn the basics of reporting and writing news stories, but also the traditions behind the craft and the evolving role of journalism in society. Instruction will include interviewing skills, fact-checking, word choice and story structure—all framed by guidance on making ethically sound decisions. Assignments could include stories from a variety of beats (business, entertainment, government, science), along with deadline stories and breaking news Web updates, profiles and obituaries.

**ENGL 213. Introduction to Fiction Writing. 3 Units.**
A beginning workshop in fiction writing, introducing such concepts as voice, point of view, plot, characterization, dialogue, description, and the like. May include discussion of literary examples, both classic and contemporary, along with student work.

**ENGL 214. Introduction to Poetry Writing. 3 Units.**
A beginning workshop, focusing on such elements of poetry as verseform, syntax, figures, sound, tone. May include discussion of literary examples as well as student work.

**ENGL 217A. Business and Professional Writing. 3 Units.**
An introduction to professional communication in theory and practice. Special attention paid to audience analysis, persuasive techniques in written and oral communication, document design strategies, and ethical communication practices. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

**ENGL 217B. Writing for the Health Professions. 3 Units.**
This course offers practice and training in the professional and technical writing skills common to health professions (e.g., medicine, nursing, dentistry). Attention will be paid to the writing processes of drafting, revising, and editing. Typical assignments include: letters, resumes, personal essays, professional communication genres (e.g., email, reports, patient charts, and histories), and scholarly genres (e.g., abstracts, articles, and reviews). Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

**ENGL 257B. Poetry. 3 Units.**
Introductory readings in poetry. May be organized chronologically or thematically. Some attention to the novel as a historically situated genre.

**ENGL 257B. Poetry. 3 Units.**
Introductory readings in poetry. May be organized chronologically or thematically. Some attention to the novel as a historically situated genre.

**ENGL 270. Introduction to Gender Studies. 3 Units.**
This course introduces women and men students to the methods and concepts of gender studies, women’s studies, and feminist theory. An interdisciplinary course, it covers approaches used in literary criticism, history, philosophy, political science, sociology, anthropology, psychology, film studies, cultural studies, art history, and religion. It is the required introductory course for students taking the women’s and gender studies major. Offered as ENGL 270, HSTY 270, PHIL 270, RLGN 270, SOCI 201, and WGST 201. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

**ENGL 285. Special Topics Seminar. 3 Units.**
Seminars on special topics in literature or language. Maximum of 3 credits.
ENGL 290. Masterpieces of Continental Fiction. 3 Units.
Major works of fiction from the 19th century and earlier. Offered as ENGL 290 and WLIT 290.

ENGL 300. English Literature to 1800. 3 Units.
A survey of major British authors from Chaucer to Milton and Dryden. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 301. Linguistic Analysis. 3 Units.
Analysis of modern English from various theoretical perspectives: structural, generative, discourse analytical, sociolinguistic, psycholinguistic, and cognitive linguistic. Some attention to the major dialects of American English. Offered as ENGL 301 and ENGL 401. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 302. English Literature since 1800. 3 Units.
A survey of major British authors from Wordsworth to the present. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 303. Intermediate Writing Workshop: Fiction. 3 Units.
Continues developing the concepts and practice of the introductory courses, with reading, writing, and discussion of fiction in various forms, including the short story, the novella and the novel. Maximum 6 credits. Prereq: ENGL 203 or ENGL 213.

ENGL 303C. Intermediate Fiction Capstone. 3 Units.
This Capstone course continues developing the concepts and practice of the introductory courses, with reading, writing, and discussion of fiction in various forms, including the short story, the novella and the novel. Offered as ENGL 303 and ENGL 303C. Students taking this course for their SAGES Capstone will not be repeating material they covered in ENGL 303. Students registering for ENGL 303C will be required to develop and complete a Capstone project, which will include a minimum of two short stories (or an alternative writing project developed in conjunction with the instructor) and a critical introduction to the project. Capstone students will also make a public presentation of their work. Counts as SAGES Senior Capstone. Prereq: (ENGL 203 or 213), ENGL 303 and ENGL 380.

ENGL 304. Intermediate Writing Workshop: Poetry. 3 Units.
Continues developing the concepts and practice of the introductory courses, with emphasis on experiment and revision as well as consideration of poetic genres through examples from established poets. Maximum 6 credits. Prereq: ENGL 203 or ENGL 214.

ENGL 304C. Poetry Writing Capstone. 3 Units.
This Capstone course continues developing the concepts and practice of the introductory courses, with emphasis on experiment and revision as well as consideration of poetic genres through examples from established poets. Offered as ENGL 304 and ENGL 304C. There will be a midterm presentation and a Capstone poetry project. Students taking this course for their SAGES Capstone will not be repeating material they covered in ENGL 304. They will be required to complete 25 pages of creative writing and 15 pages of critical writing and attend some separate meetings to discuss their progress on the Capstone project. Capstone students will also be required to present reports on their research projects at a public Capstone presentation at the end of the semester. Counts as SAGES Senior Capstone. Prereq: (ENGL 214 or 203), ENGL 304 and ENGL 380.

ENGL 305. Playwriting. 3 Units.
Theory and practice of dramatic writing, in the context of examples, classic and contemporary. Recommended preparation: ENGL 203 or ENGL 213 or ENGL 214 or ENGL 303 or ENGL 304. Offered as ENGL 305, THTR 312 and THTR 412.

ENGL 306. Intermediate Writing Workshop: Creative Non-Fiction. 3 Units.
A writing workshop that focuses on non-fiction. Students will study and write narrative journalism, the memoir, and the personal essay. Maximum 6 credits. Prereq: ENGL 203 or ENGL 213 or ENGL 214.

ENGL 307. Feature/Magazine Writing. 3 Units.
Continues developing the concepts and practices of the introductory course, with emphasis on feature writing for magazines (print and online), story structure, fact-checking, reporting techniques and freelancing. A student may not receive credit for both ENGL 307 and ENGL 307C. Prereq: ENGL 204 or instructor approval.

ENGL 307C. Feature/Magazine Writing Capstone. 3 Units.
This Capstone course continues developing the concepts and practices of the introductory course, with emphasis on feature writing for magazines (print and online), story structure, fact-checking, reporting techniques and freelancing. Students registering for 307C will be required to develop and complete a Capstone project in the wider field of study covered by the course and to make a public presentation of this project. The Capstone version of the class (307C) will expand the requirements to include a student-conceived magazine-length feature story independently overseen by the instructor, along with a reflective essay, pitch letter to a magazine, and oral presentation. A student may not receive credit for both ENGL 307 and ENGL 307C. Counts as SAGES Senior Capstone. Prereq: ENGL 204 and ENGL 380 or requisites not met permission.

ENGL 308. American Literature. 3 Units.
A survey of major American authors from the Puritans to the present. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 309. Immersion Journalism/Multimedia Storytelling. 3 Units.
Students will spend the bulk of the semester documenting lives and stories from a local nursing home through audio slideshows and video projects. A student may not receive credit for both ENGL 309 and ENGL 309C. Prereq: ENGL 204 or instructor approval.

ENGL 309C. Multimedia Storytelling Capstone. 3 Units.
This Capstone course will require that students spend the bulk of the semester documenting lives and stories from a local nursing home through audio slideshows and video projects. Students who register for 309C to fulfill their SAGES Capstone requirement will individually plan, shoot and edit a 7-10 minute documentary, compose a 15 page reflective essay, and complete an oral presentation. A student may not receive credit for both ENGL 309 and ENGL 309C. Counts as SAGES Senior Capstone. Prereq: ENGL 204 and ENGL 380 or requisites not met permission.

ENGL 310. History of the English Language. 3 Units.
An introductory course covering the major periods of English language development: Old, Middle, and Modern. Students will examine both the linguistic forms and the cultures in which the forms were used. Offered as ENGL 310 and ENGL 410. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 312. Chaucer. 3 Units.
An introduction to the work of Geoffrey Chaucer, with emphasis on "The Canterbury Tales." A student may not receive credit for both ENGL 312 and ENGL 312C. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.
ENGL 312C. Chaucer Capstone. 3 Units.
This capstone course is an introduction to the work of Geoffrey Chaucer, with emphasis on "The Canterbury Tales." Students registering for 312C will be required to develop and complete a Capstone project in the wider field of study covered by the course and to make a public presentation of this project. A student may not receive credit for both ENGL 312 and ENGL 312C. Counts as SAGES Senior Capstone. Prereq: ENGL 380 and (ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 314. Advanced Playwriting. 3 Units.
Theory and practice of dramatic writing with special focus on the craft of writing a full-length play. Offered as ENGL 314, THTR 314 and THTR 414. Prereq: ENGL 305 or THTR 312.

ENGL 316. Screenwriting. 3 Units.
A critical exploration of the craft of writing for film, in which reading and practicum assignments will culminate in the student submitting an original full-length screenplay. Offered as ENGL 316, THTR 316 and THTR 416. Prereq: THTR 314 or ENGL 305 or THTR 412.

ENGL 320. Renaissance Literature. 3 Units.
Aspects of English Renaissance literature and its contexts from 1500-ca. 1620. Genres studied might include poetry, drama, prose fiction, expository and polemic writing, or some works from Continental Europe. Writers such as Skelton, More, Erasmus, Wyatt, Sidney, Spenser, Marlowe, Lanier, Wroth, Shakespeare, Donne. Maximum 6 credits. Offered as ENGL 320 and ENGL 420. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 323. Milton. 3 Units.
Poetry and selected prose, including the careful study of "Paradise Lost." Offered as ENGL 323 and ENGL 423. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 324. Shakespeare: Histories and Tragedies. 3 Units.
Close reading of a selection of Shakespeare's plays and history plays (e.g., "Richard the Third," "Julius Caesar," "Hamlet," "King Lear"). Topics of discussion may include Renaissance drama as a social institution, the nature of tragedy; national history, gender roles, sexual politics, the state and its opponents, theatrical conventions. Assessment may include opportunities for performance. A student who has previously taken ENGL 324 may receive credit for ENGL 324C only if the themes/topics are different. Counts as SAGES Senior Capstone. Prereq: ENGL 380 and (ENGL 310 or 312 or 320 or 323 or 325 or 327 or 328 or 329).

ENGL 325. Shakespeare: Comedies and Romances. 3 Units.
Close reading of selected plays of Shakespeare in the genres of comedy and romance (e.g., "The Merchant of Venice," "Twelfth Night," "Measure for Measure," "The Tempest"). Topics of discussion may include issues of sexual desire, gender roles, marriage, the family, genre conventions. Assessment may include opportunities for performance. A student who has previously taken ENGL 325 may receive credit for ENGL 325C. Offered as ENGL 325, ENGL 425, and THTR 335. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 325C. Shakespeare: Comedies/Romances Capstone. 3 Units.
Close reading of selected plays of Shakespeare in the genres of comedy and romance (e.g., "The Merchant of Venice," "Twelfth Night," "Measure for Measure," "The Tempest"). Topics of discussion may include issues of sexual desire, gender roles, marriage, the family, genre conventions. Assessment may include opportunities for performance. A student who has previously taken ENGL 325 may receive credit for ENGL 325C. Offered as ENGL 325, ENGL 425, and THTR 335. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 328. Studies in the Eighteenth Century. 3 Units.
This course examines selected topics in the English literary culture of the eighteenth century, a culture which extended to the Americas and other English colonies. Literature writings will be examined in relation to other aspects of the century's culture, which may include visual arts, marital institutions, the printing industry, property law, medicine, and other topics. Maximum 6 credits. Offered as ENGL 328 and ENGL 428. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 329. Studies in 18th Century Capstone. 3 Units.
This Capstone course examines selected topics in the English literary culture of the eighteenth century, a culture which extended to the Americas and other English colonies. Literature writings will be examined in relation to other aspects of the century's culture, which may include visual arts, marital institutions, the printing industry, property law, medicine, and other topics. Students registering for 329C will be required to develop and complete a Capstone project in the wider field of study covered by the course and to make a public presentation of this project. A student who has previously taken ENGL 329 may receive credit for ENGL 329C only if the themes/topics are different. Counts as SAGES Senior Capstone. Prereq: ENGL 380 and (ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).
ENGL 329. English Literature, 1780-1837. 3 Units.
Aspects of English literature and its contexts in the early 19th century.
Genres might include poetry, prose fiction, political and philosophical
writing, literary theory of the period. Writers such as Wordsworth,
Coleridge, Blake, Austen, Byron, the Shelleys. Maximum 6 credits. Offered
as ENGL 329 and ENGL 429. Prereq: ENGL 150 or passing letter grade in a
100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 330. Victorian Literature. 3 Units.
Aspects of English literature and its contexts during the reign of Queen
Victoria. Genres studied might include poetry, prose fiction, political
and philosophical writing. Writers such as the Brontes, Gaskell, Dickens,
Eliot, Hardy, Tennyson, the Brownings, Arnold, Carlyle, Ruskin, Gosse,
Swinburne, and Hopkins. Maximum 6 credits. Offered as ENGL 330 and
ENGL 430. Prereq: ENGL 150 or passing letter grade in a 100 level first
year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 330C. Victorian Literature Capstone. 3 Units.
This Capstone course studies aspects of English literature and its
contexts during the reign of Queen Victoria. Genres studied might include
poetry, prose fiction, political and philosophical writing. Writers such as
the Brontes, Gaskell, Dickens, Eliot, Hardy, Tennyson, the Brownings,
Arnold, Carlyle, Ruskin, Gosse, Swinburne, and Hopkins. Students
registering for 330C will be required to develop and complete a Capstone
project in the wider field of study covered by the course and to make a
public presentation of this project. A student who has previously taken
ENGL 330 may receive credit for ENGL 330C only if the themes/topics
are different. Counts as SAGES Senior Capstone. Prereq: ENGL 380 and
(ENGL 150 or passing letter grade in a 100 level first year seminar in
FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 331. Studies in the Nineteenth-Century. 3 Units.
Individual topics in English literary culture of the 19th century. Topics
might be thematic or formal, such as literature and science; medicine;
labor; sexuality; Empire; literature and other arts; Gothic fiction;
decadence. Maximum 6 credits. Offered as ENGL 331 and ENGL 431.
Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in
FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 331C. Studies in the Nineteenth Century Capstone. 3 Units.
This Capstone course studies individual topics in English literary culture
of the 19th century. Topics might be thematic or formal, such as literature
and science; medicine; labor; sexuality; Empire; literature and other arts;
Gothic fiction; decadence. Students registering for 331C will be required
to develop and complete a Capstone project in the wider field of study
covered by the course and to make a public presentation of this project.
A student who has previously taken ENGL 331 may receive credit for
ENGL 331C only if the themes/topics are different. Counts as SAGES Senior Capstone. Prereq: ENGL 380 and (ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 332. Twentieth-Century British Literature. 3 Units.
Aspects of British literature (broadly interpreted) and its contexts during
the 20th century. Genres studied might include poetry, fiction, and drama.
Such writers as Joyce, Woolf, Conrad, Ford, Lawrence, Mansfield, Shaw,
Beckett, Stoppard, Yeats, Edward or Dylan Thomas, Stevie Smith, Bowen,
Spark. Maximum 6 credits. Offered as ENGL 332 and ENGL 432. Prereq:
ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC,
FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 333. Studies in the Twentieth and Twenty-first Centuries. 3 Units.
Individual topics in twentieth- and twenty-first century literary culture.
Particular issues and topics may cross national boundaries and genre
lines as well as exploring political, psychological, and social themes, such
as movements, comparative studies across the arts, literature and war,
literature and occultism. Maximum 6 credits. Offered as ENGL 333 and
ENGL 433. Prereq: ENGL 150 or passing letter grade in a 100 level first
year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 341. Rhetoric of Science and Medicine. 3 Units.
This course explores the roles language and rhetoric play in constructing,
communicating, and understanding science and medicine. It surveys
current and historical debates, theories, research, and textual
conventions of scientific and medical discourse. May be taught with
a specific focus, such as scientific controversies, concepts of health and
illness, visualizations of science, the body in medicine, and the history
of scientific writing. A student may not receive credit for both ENGL 341
and ENGL 341C. Offered as: ENGL 341, ENGL 341C, and ENGL 441. Prereq:
ENGL 150 or letter grade in SAGES First Seminar.

ENGL 341C. Rhetoric of Science & Medicine Capstone. 3 Units.
This course explores the roles language and rhetoric play in constructing,
communicating, and understanding science and medicine. It surveys
current and historical debates, theories, research, and textual
conventions of scientific and medical discourse. May be taught with a
specific focus, such as scientific controversies, concepts of health and
illness, visualizations of science, the body in medicine, and the history
of scientific writing. Students registering for ENGL 341C will be required
to develop and complete a Capstone project in the wider field of study
covered by the course and to make a public presentation of this project.
A student may not receive credit for both ENGL 341 and ENGL 341C.
Offered as ENGL 341, ENGL 341C and ENGL 441. Counts as SAGES Senior
Capstone. Prereq: ENGL 380 and (ENGL 150 or passing letter grade in a
100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 343. Language and Gender. 3 Units.
This course introduces students to the study of language and gender
by exploring historical and theoretical trends, methods, and research
findings on the ways gender, sexuality, language, and discourse interact
with and even shape each other. Topics may include "grammatical"
versus "biological" gender, feminine escriture, the women and language
debate, speech acts and queer performativity, nonsexist language
policy, discourses of gender and sexuality, feminist stylistics, and LGBT
sociolinguistics. Offered as ENGL 343, ENGL 443, and WGST 343. Counts
for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or
passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO,
FSSY, FSTS, or FSCS.

ENGL 345. Topics in LGBT Studies. 3 Units.
This course will focus on selected topics in the study of LGBT literature,
film, theory, and culture. Individual courses may focus on such topics as
queer theory, LGBT literature, queer cinema, gay and lesbian poetry, LGBT
graphic novels, the AIDS memoir, AIDS/Gay Drama, and queer rhetoric
and protest. Maximum 6 credits. Offered as ENGL 345, ENGL 445 and
WGST 345. Counts for CAS Global & Cultural Diversity Requirement.
Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in
FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.
ENGL 345C. Topics in LGBT Studies Capstone. 3 Units.
This Capstone course will focus on selected topics in the study of LGBT literature, film, theory, and culture. Individual courses may focus on such topics as queer theory, LGBT literature, queer cinema, gay and lesbian poetry, LGBT graphic novels, the AIDS memoir, queer new media, AIDS activism, and AIDS/Gay Drama. Students registering for 345C will be required to develop and complete a Capstone project in the wider field of study covered by the course and to make a public presentation of this project. Counts for CAS Global & Cultural Diversity Requirement. A student who has previously taken ENGL 345 may receive credit for ENGL 345C only if the themes/topics are different. Counts as SAGES Senior Capstone. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 380 and (ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 353. Major Writers. 3 Units.
Close and detailed study of the work of one or two writers: development, social and aesthetic contexts, reception, interpretation, significance. Maximum 6 credits. Offered as ENGL 353 and ENGL 453. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 356. American Literature Before 1865. 3 Units.
Aspects of American literature and its contexts from the colonial period through the end of the Civil War. Writers such as Bradstreet, Taylor, Franklin, Poe, Stowe, Alcott, Melville, Hawthorne, Emerson, Douglass. Maximum 6 credits. Offered as ENGL 356 and ENGL 456. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 358. American Literature 1914-1960. 3 Units.
Aspects of American literature and its contexts from the First World War to the Cold War. Genres studied might include fiction, poetry, drama, polemics. Writers such as T.S. Eliot, Pound, Stevens, Moore, W.C. Williams, Dos Passos, West, Fitzgerald, Hemingway, Cather, Faulkner, Barnes, Miller, T. Williams, O’Neill. Maximum 6 credits. Offered as ENGL 358 and ENGL 458. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 358C. American Literature, 1914-1960 Capstone. 3 Units.
This Capstone course presents aspects of American literature and its contexts from the First World War to the Cold War. Genres studied might include fiction, poetry, drama, polemics. Writers such as T.S. Eliot, Pound, Stevens, Moore, W.C. Williams, Dos Passos, West, Fitzgerald, Hemingway, Cather, Faulkner, Barnes, Miller, T. Williams, O’Neill. Students registering for 358C will be required to develop and complete a Capstone project in the wider field of study covered by the course and to make a public presentation of this project. A student who has previously taken ENGL 358 may receive credit for ENGL 358C only if the themes/topics are different. Counts as SAGES Senior Capstone. Prereq: ENGL 380 and (ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 359. Studies in Contemporary American Literature. 3 Units.
Individual topics in literary culture since the 1960s. Topics may include the Beats, literature of the Vietnam war, post-modern fiction, contemporary poetry, the documentary novel. Maximum 6 credits. Offered as ENGL 359 and ENGL 459. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 360. Studies in American Literature. 3 Units.
Individual topics in American literary culture such as regionalism, realism, impressionism, literature and popular culture, transcendentalism, the lyric, proletarian literature, the legacy of the Civil War. Maximum 6 credits. Offered as ENGL 360 and ENGL 460. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 363H. African-American Literature. 3 Units.
A historical approach to African-American literature. Such writers as Wheatley, Equiano, Douglass, Jacobs, DuBois, Hurston, Hughes, Wright, Baldwin, Ellison, Morrison. Topics covered may include slave narratives, African-American autobiography, the Harlem Renaissance, the Black Aesthetic, literature of protest and assimilation. Maximum 6 credits. Offered as ENGL 363H, ETHS 363H, WLIT 363H, ENGL 463H, and WLIT 463H. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 365E. The Immigrant Experience. 3 Units.
Study of fictional and/or autobiographical narrative by authors whose families have experienced immigration to the U.S. Among the ethnic groups represented are Asian-American, Jewish-American, Hispanic-American. May include several ethnic groups or focus on a single one. Attention is paid to historical and social aspects of immigration and ethnicity. Maximum 6 credits. Offered as ENGL 365E, WLIT 365E, ENGL 465E, and WLIT 465E. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 365N. Topics in African-American Literature. 3 Units.
Selected topics and writers from nineteenth, twentieth, and twenty-first century African-American literature. May focus on a genre, a single author or a group of authors, a theme or themes. Maximum 6 credits. Offered as ENGL 365N, ETHS 365N, WLIT 365N, ENGL 465N, and WLIT 465N. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 365NC. Topics in African American Literature Capstone. 3 Units.
Selected topics and writers from nineteenth, twentieth, and twenty-first century African-American literature. May focus on a genre, a single author or a group of authors, a theme or themes. Students registering for 365NC will be required to develop and complete a Capstone project in the wider field of study covered by the course and to make a public presentation of this project. A student who has previously taken ENGL 365N, ETHS 365N, or WLIT 365N may receive credit for ENGL 365NC only if the themes/topics are different. Offered as ENGL 365N, ENGL 465N, ETHS 365N, WLIT 365N, and WLIT 465N. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 380 and (ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 365Q. Post-Colonial Literature. 3 Units.
Readings in national and regional literatures from former European colonies such as Australia and African countries. Maximum 6 credits. Offered as ENGL 365Q, ETHS 365Q, WLIT 365Q, ENGL 465Q, and WLIT 465Q. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.
ENGL 366G. Minority Literatures. 3 Units.
A course dealing with literature produced by ethnic and racial minority
groups within the U.S. Individual offerings may include works from
several groups studied comparatively, or focus on a single group, such as
Native Americans, Chicanos/Chicanas, Asian-Americans, Caribbean-
Americans. African-American works may also be included. May cover the
entire history of the U.S. or shorter periods. Maximum 6 credits. Offered as
ENGL 366G, WLIT 366G, ENGL 466G, and WLIT 466G. Counts for CAS
Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing
letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY,
FSTS, or FSCS.

ENGL 367. Introduction to Film. 3 Units.
An introduction to the aesthetics of film form. We will analyze the
elements that make up a film, screening films that facilitate our
discussion of how these elements interact with one another to constitute
whole formal systems that generate meanings and other effects. We
will bring various theoretical and historical considerations to bear as
we explore and appreciate the art of cinema. Offered as ENGL 367 and
ENGL 467.

ENGL 368. Topics in Film. 3 Units.
Individual topics in film, such as a particular national cinema, horror
films, films of Alfred Hitchcock, images of women in film, film comedy,
introduction to film genres, Asian-cinema and drama, dance on screen,
science fiction films, storytelling and cinema, and literature and film.
A student who has previously taken ENGL 368C may receive credit for
ENGL 368 only if the themes/topics are different. Offered as ENGL 368,
ENGL 468, WLIT 368, and WLIT 468.

ENGL 368C. Topics in Film Capstone. 3 Units.
Individual topics in film, such as a particular national cinema, horror films,
films of Alfred Hitchcock, images of women in film, film comedy, film
genres, Asian-cinema and drama, dance on screen, science fiction films,
storytelling and cinema, and literature and film. Students registering
for ENGL 368C will be required to develop and complete a Capstone
project in the wider field of study covered by the course and to make a
public presentation of this project. Students must be a declared English
Major with Concentration in Film or both English Major and Film Minor.
Permission of instructor must be received prior to the last day of classes
the previous semester. A student who has previously taken ENGL 368
may receive credit for ENGL 368C only if the themes/topics are different.
Counts as SAGES Senior Capstone. Prereq: ENGL 380 and (ENGL 150 or
passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO,
FSSY, FSTS, or FSCS).

ENGL 369. Children's Literature. 3 Units.
Individual topics in 19th-, 20th-, and 21st-century children's literature.
Topics may focus on narrative and thematic developments in the genre,
historical contexts, literary influences, or adaptations of children's
literature into film and other media. Offered as ENGL 369 and ENGL 469.
Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar
in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 370. Comics and the Graphic Novel. 3 Units.
Selected topics in the study and analysis of comics and the graphic
novel. Topics may include historical contexts of the genre, visual rhetoric,
themetic developments, influence of literature, adaptations into film.
A student may not receive credit for both ENGL 370 and ENGL 370C.
Offered as ENGL 370, ENGL 370C, and ENGL 470. Prereq: ENGL 150 or
passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO,
FSSY, FSTS, or FSCS.

ENGL 370C. Comics and the Graphic Novel Capstone. 3 Units.
Selected topics in the study and analysis of comics and the graphic
novel. Topics may include historical contexts of the genre, visual rhetoric,
themetic developments, influence of literature, adaptations into film.
Students registering for 370C will be required to develop and complete a
Capstone project in the wider field of study covered by the course
and to make a public presentation of this project. A student may not
receive credit for both ENGL 370 and ENGL 370C. Offered as ENGL 370,
ENGL 370C, and ENGL 470. Counts as SAGES Senior Capstone. Prereq:
ENGL 380 and (ENGL 150 or passing letter grade in a 100 level first year
seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS).

ENGL 371. Topics in Women's and Gender Studies. 3 Units.
Individual topics and issues in women's studies relating to writing by
and about women, such as feminist theory and criticism; the politics of
gender and sexuality; women in popular culture; women in the writing
business. Maximum 6 credits. Offered as ENGL 371 and ENGL 471.
Counts for CAS Global & Cultural Diversity Requirement. Prereq:
ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC,
FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 372. Studies in the Novel. 3 Units.
Selected topics in the history and formal development of the novel,
such as detective novels; science fiction; epistolary novels; the rise of
the novel; the stream of consciousness novel; the Bildungsroman in
English. Maximum 6 credits. Offered as ENGL 372 and ENGL 472. Prereq:
ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC,
FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 372C. Studies in the Novel Capstone. 3 Units.
This Capstone course studies selected topics in the history and formal
development of the novel, such as detective novels; science fiction;
epistolary novels; the rise of the novel; the stream of consciousness
novel; the Bildungsroman in English. Students registering for 372C will
be required to develop and complete a Capstone project in the wider
field of study covered by the course and to make a public presentation of
this project. A student who has previously taken ENGL 372 may receive
credit for ENGL 372C only if the themes/topics are different. Counts as
SAGES Senior Capstone. Prereq: ENGL 380 and (ENGL 150 or passing
letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY,
FSTS, or FSCS).

ENGL 373. Studies in Poetry. 3 Units.
Selected topics in the study of poetry, such as reading poetry,
the elegy, pastoral poetry, love poetry, the long poem, form and meter in
poetry. Maximum 6 credits. Offered as ENGL 373 and ENGL 473. Prereq:
ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC,
FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 374. Internship in Journalism. 3 - 6 Units.
Students work as interns at area newspapers, magazines, trade
publications, radio or television and meet as a class to share their
experiences as interns and to focus on editorial issues--reporting, writing,
fact-checking, editing--that are a part of any journalistic enterprise.
Students are responsible for pre-arranging their internships prior to the
semester they intend to take the class but can expect guidance from
the instructor in this regard. Recommended preparation: ENGL 204 or
permission of the department.

ENGL 376. Studies in Genre. 3 Units.
Topics in literary genres, such as comedy, biography and autobiography,
satire, allegory, the short story, the apologue, narrative poetry. May cross
over the prose/poetry boundary. Maximum 6 credits. Offered as ENGL 376
and ENGL 476. Prereq: ENGL 150 or passing letter grade in a 100 level
first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.
ENGL 377. Studies in Drama. 3 Units.
Readings and discussion of plays and related critical literature pertaining to a specific period in American or British drama. Topics and material will vary from semester to semester. Offered as ENGL 377 and ENGL 477. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 378. Topics in Visual and New Media Studies. 3 Units.
This course will focus on selected topics in the study of visual rhetoric and/or new media, including theoretical, critical, and historical issues raised by texts and media platforms that communicate largely through visual means or through the interaction of visual and verbal modes. Possible syllabi may focus on topics such as visual rhetoric; new media story-telling; historical perspectives on visual rhetoric and/or new media; concentrations on a particular genre (for instance, the graphic novel, video games, etc.); visual narrative; theories of new media, etc. Offered as ENGL 378 and ENGL 478. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 379. Topics in Language Studies. 3 Units.
Aspects of contemporary language studies. Topics might include history/theories of rhetoric, discourse studies, cognitive linguistics, metaphor, language acquisition, stylistics. Maximum 9 credits. Offered as ENGL 379 and ENGL 479. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 380. Departmental Seminar. 3 Units.
A topical course, emphasizing disciplinary forms of writing. Required of all English majors, preferable in the junior year; also fulfills a SAGES requirement. Counts as SAGES Departmental Seminar. Prereq: ENGL 300.

ENGL 385. Special Topics in Literature. 3 Units.
Close study of a theme or aspect of literature not covered by traditional generic or period rubrics, such as "spatial imagination," "semiotics of fashion in literature," "epistolarity." Maximum 9 credits. Offered as ENGL 385 and ENGL 485. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 386. Studies in Literature and Culture. 3 Units.
Boundary-crossing study of the relations between literary and other aspects of a particular culture or society; including theoretical and critical issues raised by such study. For example, literature and medicine, law and literature, gay and lesbian literature, Asian/Western literary relations, emotion in literature, philosophy and literature, literature and music. Maximum 9 credits. Offered as ENGL 386 and ENGL 486. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 387. Literary and Critical Theory. 3 Units.
A survey of major schools and texts of literary and critical theory. May be historically or thematically organized. Maximum 6 credits. Offered as ENGL 387, WLIT 387, ENGL 487, and WLIT 487. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 390. Independent Study and Creative Projects. 1 - 3 Units.
Up to three semester hours of independent study may be taken in a single semester. Must have prior approval of faculty member directing the project. Projects may be critical or creative in nature.

ENGL 392. Classroom Teaching. 3 Units.
For undergraduate students who assist in the teaching of ENGL 150, 180, or 181. Interested students should check with the director of composition (for ENGL 150, 180, 181) before the beginning of the semester in which they wish to participate. May be repeated only once; not more than three semester hours in ENGL 392 may be counted toward the major. May also include up to three semester hours of supervised peer tutoring at the University Writing Center.

ENGL 398. Professional Communication for Engineers. 2 Units.
A writing course for Engineering students only, covering academic and professional genres of written and oral communication. Taken in conjunction with Engineering 398, English 398 constitutes an approved SAGES Departmental Seminar. Counts as SAGES Departmental Seminar. Prereq or Coreq: ENGR 398. Prereq: 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ENGL 400. Rhetoric and Teaching of Writing. 3 Units.
Classical and modern theories of rhetoric; their application in the classroom. Required of graduate assistants and tutors who have had no prior experience in the teaching of composition. Prereq: Graduate standing.

ENGL 401. Linguistic Analysis. 3 Units.
Analysis of modern English from various theoretical perspectives: structural, generative, discourse analytical, sociolinguistic, psycholinguistic, and cognitive linguistic. Some attention to the major dialects of American English. Offered as ENGL 301 and ENGL 401. Prereq: Graduate standing.

ENGL 406. Advanced Creative Writing. 3 Units.
Workshop for serious undergraduate and graduate writers. Offered alternate years; alternates between poetry and fiction. Admission requires review of writing sample by faculty. Maximum 6 credits. Prereq: Graduate standing.

ENGL 410. History of the English Language. 3 Units.
An introductory course covering the major periods of English language development: Old, Middle, and Modern. Students will examine both the linguistic forms and the cultures in which the forms were used. Offered as ENGL 310 and ENGL 410. Prereq: Graduate standing.

ENGL 420. Renaissance Literature. 3 Units.
Aspects of English Renaissance literature and its contexts from 1500-ca. 1620. Genres studied might include poetry, drama, prose fiction, expository and polemic writing, or some works from Continental Europe. Writers such as Skelton, More, Erasmus, Wyatt, Sidney, Spenser, Marlowe, Lanier, Wroth, Shakespeare, Donne. Maximum 6 credits. Offered as ENGL 320 and ENGL 420. Prereq: Graduate standing.

ENGL 423. Milton. 3 Units.
Poetry and selected prose, including the careful study of "Paradise Lost." Offered as ENGL 323 and ENGL 423. Prereq: Graduate standing.

ENGL 424. Shakespeare: Histories and Tragedies. 3 Units.
Close reading of a selection of Shakespeare's tragedies and history plays (e.g., "Richard the Third," "Julius Caesar," "Hamlet," "King Lear"). Topics of discussion may include Renaissance drama as a social institution, the nature of tragedy, national history, gender roles, sexual politics, the state and its opponents, theatrical conventions. Assessment may include opportunities for performance. A student may not receive credit for both ENGL 324 and ENGL 324C. Offered as ENGL 324, ENGL 424, and THTR 334. Prereq: Graduate standing.
ENGL 425. Shakespeare: Comedies and Romances. 3 Units.
Close reading of selected plays of Shakespeare in the genres of comedy and romance (e.g., “The Merchant of Venice,” “Twelfth Night,” “Measure for Measure,” “The Tempest”). Topics of discussion may include issues of sexual desire, gender roles, marriage, the family, genre conventions. Assessment may include opportunities for performance. A student may not receive credit for both ENGL 325 and ENGL 325C. Offered as ENGL 325, ENGL 425, and THTR 335. Prereq: Graduate standing.

ENGL 427. Eighteenth-Century Literature. 3 Units.
Survey of a variety of writings from or relevant to the eighteenth century. Writers discussed may include Dryden, Behn, Defoe, Pope, Swift, Gay, Fielding, Richardson, Burney, Wollstonecraft and others working in drama, lyric and epic poetry, biography and autobiography, political and philosophical writings and prose fiction. Thematic approaches may include: satire, journalism and literature, the rise of the novel. Maximum 6 credits. Offered as ENGL 327 and ENGL 427. Prereq: Graduate standing or permission of instructor.

ENGL 428. Studies in the Eighteenth Century. 3 Units.
This course examines selected topics in the English literary culture of the eighteenth century, a culture which extended to the Americas and to other English colonies. Literary writings will be examined in relation to other aspects of the century’s culture, which may include visual arts, marital institutions, the printing industry, property law, medicine, and other topics. Maximum 6 credits. Offered as ENGL 328 and ENGL 428. Prereq: Graduate standing.

ENGL 429. English Literature, 1780-1837. 3 Units.
Aspects of English literature and its contexts in the early 19th century. Genres might include poetry, prose fiction, political and philosophical writing, literary theory of the period. Writers such as Wordsworth, Coleridge, Blake, Austen, Byron, the Shelleys. Maximum 6 credits. Offered as ENGL 329 and ENGL 429. Prereq: Graduate standing.

ENGL 430. Victorian Literature. 3 Units.
Aspects of English literature and its contexts during the reign of Queen Victoria. Genres studied might include poetry, prose fiction, political and philosophical writing. Writers such as the Brontes, Gaskell, Dickens, Eliot, Hardy, Tennyson, the Brownings, Arnold, Carlyle, Ruskin, Gosse, Swinburne, and Hopkins. Maximum 6 credits. Offered as ENGL 330 and ENGL 430. Prereq: Graduate standing or permission of instructor.

ENGL 431. Studies in the Nineteenth-Century. 3 Units.
Individual topics in English literary culture of the 19th century. Topics might be thematic or formal, such as literature and science, medicine; labor; sexuality; Empire; literature and other arts; Gothic fiction; decadence. Maximum 6 credits. Offered as ENGL 331 and ENGL 431. Prereq: Graduate standing.

ENGL 432. Twentieth-Century British Literature. 3 Units.
Aspects of British literature (broadly interpreted) and its contexts during the 20th century. Genres studied might include poetry, fiction, and drama. Such writers as Joyce, Woolf, Conrad, Ford, Lawrence, Mansfield, Shaw, Beckett, Stoppard, Yeats, Edward or Dylan Thomas, Stevie Smith, Bowen, Spark. Maximum 6 credits. Offered as ENGL 332 and ENGL 432. Prereq: Graduate standing.

ENGL 433. Studies in the Twentieth and Twenty-first Centuries. 3 Units.
Individual topics in twentieth- and twenty-first century literary culture. Particular issues and topics may cross national boundaries and genre lines as well as exploring political, psychological, and social themes, such as movements, comparative studies across the arts, literature and war, literature and occultism. Maximum 6 credits. Offered as ENGL 333 and ENGL 433. Prereq: Graduate standing.

ENGL 441. Rhetoric of Science and Medicine. 3 Units.
This course explores the roles language and rhetoric play in constructing, communicating, and understanding science and medicine. It surveys current and historical debates, theories, research, and textual conventions of scientific and medical discourse. May be taught with a specific focus, such as scientific controversies, concepts of health and illness, visualizations of science, the body in medicine, and the history of scientific writing. A student may not receive credit for both ENGL 341 and ENGL 341C. Offered as: ENGL 341, ENGL 341C, and ENGL 441. Prereq: Graduate standing.

ENGL 443. Language and Gender. 3 Units.
This course introduces students to the study of language and gender by exploring historical and theoretical trends, methods, and research findings on the ways gender, sexuality, language, and discourse interact with and even shape each other. Topics may include "grammatical" versus "biological" gender, feminine écriture, the women and language debate, speech acts and queer performativity, nonsexist language policy, discourses of gender and sexuality, feminist stylistics, and LGBT sociolinguistics. Offered as ENGL 343, ENGL 443, and WGST 343. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

ENGL 445. Topics in LGBT Studies. 3 Units.
This course will focus on selected topics in the study of LGBT literature, film, theory, and culture. Individual courses may focus on such topics as queer theory, LGBT literature, queer cinema, gay and lesbian poetry, LGBT graphic novels, the AIDS memoir, AIDS/Gay Drama, and queer rhetoric and protest. Maximum 6 credits. Offered as ENGL 345, ENGL 445 and WGST 345. Counts for CAS Global & Cultural Diversity Requirement.

ENGL 453. Major Writers. 3 Units.
Close and detailed study of the work of one or two writers: development, social and aesthetic contexts, reception, interpretation, significance. Maximum 6 credits. Offered as ENGL 353 and ENGL 453. Prereq: Graduate standing.

ENGL 456. American Literature Before 1865. 3 Units.
Aspects of American literature and its contexts from the colonial period through the end of the Civil War. Writers such as Bradstreet, Taylor, Franklin, Poe, Stowe, Alcott, Melville, Hawthorne, Emerson, Douglass. Maximum 6 credits. Offered as ENGL 356 and ENGL 456. Prereq: Graduate standing.

ENGL 458. American Literature 1914-1960. 3 Units.
Aspects of American literature and its contexts from the First World War to the Cold War. Genres studied might include fiction, poetry, drama, polemics. Writers such as T.S. Eliot, Pound, Stevens, Moore, W.C. Williams, Dos Passos, West, Fitzgerald, Hemingway, Cather, Faulkner, Barnes, Miller, T. Williams, O’Neill. Maximum 6 credits. Offered as ENGL 358 and ENGL 458. Prereq: Graduate standing.

ENGL 459. Studies in Contemporary American Literature. 3 Units.
Individual topics in literary culture since the 1960s. Topics may include the Beats, literature of the Vietnam war, post-modern fiction, contemporary poetry, the documentary novel. Maximum 6 credits. Offered as ENGL 359 and ENGL 459. Prereq: Graduate standing.

ENGL 460. Studies in American Literature. 3 Units.
Individual topics in American literary culture such as regionalism, realism, impressionism, literature and popular culture, transcendentalism, the lyric, proletarian literature, the legacy of the Civil War. Maximum 6 credits. Offered as ENGL 360 and ENGL 460. Prereq: Graduate standing or permission of instructor.
ENGL 463H. African-American Literature. 3 Units.
A historical approach to African-American literature. Such writers as Wheatley, Equiano, Douglass, Jacobs, DuBois, Hurston, Hughes, Wright, Baldwin, Ellison, Morrison. Topics covered may include slave narratives, African-American autobiography, the Harlem Renaissance, the Black Aesthetic, literature of protest and assimilation. Maximum 6 credits. Offered as ENGL 363H, ETHS 363H, WLIT 363H, ENGL 463H, and WLIT 463H. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

ENGL 465E. The Immigrant Experience. 3 Units.
Study of fictional and/or autobiographical narrative by authors whose families have experienced immigration to the U.S. Among the ethnic groups represented are Asian-American, Jewish-American, Hispanic-American, African-American. May include several ethnic groups or focus on a single one. Attention is paid to historical and social aspects of immigration and ethnicity. Maximum 6 credits. Offered as ENGL 365E, WLIT 365E, ENGL 465E, and WLIT 465E. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

ENGL 465N. Topics in African-American Literature. 3 Units.
Selected topics and writers from nineteenth, twentieth, and twenty-first century African-American literature. May focus on a genre, a single author or a group of authors, a theme or themes. Maximum 6 credits. Offered as ENGL 365N, ETHS 365N, WLIT 365N, ENGL 465N, and WLIT 465N. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

ENGL 465Q. Post-Colonial Literature. 3 Units.
Readings in national and regional literatures from former European colonies such as Australia and African countries. Maximum 6 credits. Offered as ENGL 365Q, ETHS 365Q, WLIT 365Q, ENGL 465Q, and WLIT 465Q. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

ENGL 466G. Minority Literatures. 3 Units.
A course dealing with literature produced by ethnic and racial minority groups within the U.S. Individual offerings may include works from several groups studied comparatively, or focus on a single group, such as Native Americans, Chicanos/Chicanas, Asian-Americans, Caribbean-Americans. African-American works may also be included. May cover the entire history of the U.S. or shorter periods. Maximum 6 credits. Offered as ENGL 366G, WLIT 366G, ENGL 466G, and WLIT 466G. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

ENGL 467. Introduction to Film. 3 Units.
An introduction to the aesthetics of film form. We will analyze the elements that make up a film, screening films that facilitate our discussion of how these elements interact with one another to constitute whole formal systems that generate meanings and other effects. We will bring various theoretical and historical considerations to bear as we explore and appreciate the art of cinema. Offered as ENGL 367 and ENGL 467. Prereq: Graduate standing.

ENGL 468. Topics in Film. 3 Units.
Individual topics in film, such as a particular national cinema, horror films, films of Alfred Hitchcock, images of women in film, film comedy, introduction to film genres, Asian-cinema and drama, dance on screen, science fiction films, storytelling and cinema, and literature and film. A student who has previously taken ENGL 368C may receive credit for ENGL 368 only if the themes/topics are different. Offered as ENGL 368, ENGL 468, WLIT 368, and WLIT 468. Prereq: Graduate standing.

ENGL 469. Children’s Literature. 3 Units.
Individual topics in 19th-, 20th-, and 21st-century children’s literature. Topics may focus on narrative and thematic developments in the genre, historical contexts, literary influences, or adaptations of children’s literature into film and other media. Offered as ENGL 369 and ENGL 469. Prereq: Graduate standing.

ENGL 470. Comics and the Graphic Novel. 3 Units.
Selected topics in the study and analysis of comics and the graphic novel. Topics may include historical contexts of the genre, visual rhetoric, thematic developments, influence of literature, adaptations into film. A student may not receive credit for both ENGL 370 and ENGL 370C. Offered as ENGL 370, ENGL 370C, and ENGL 470.

ENGL 471. Topics in Women’s and Gender Studies. 3 Units.
Individual topics and issues in women’s studies relating to writing by and about women, such as feminist theory and criticism; the politics of gender and sexuality; women in popular culture; women in the writing business. Maximum 6 credits. Offered as ENGL 371 and ENGL 471. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

ENGL 472. Studies in the Novel. 3 Units.
Selected topics in the history and formal development of the novel, such as detective novels; science fiction; epistolary novels; the rise of the novel; the stream of consciousness novel; the Bildungsroman in English. Maximum 6 credits. Offered as ENGL 372 and ENGL 472. Prereq: Graduate standing.

ENGL 473. Studies in Poetry. 3 Units.
Selected topics and issues in the study of poetry, such as reading poetry, the elegy, pastoral poetry, love poetry, the long poem, form and meter in poetry. Maximum 6 credits. Offered as ENGL 373 and ENGL 473. Prereq: Graduate standing.

ENGL 476. Studies in Genre. 3 Units.
Topics in literary genres, such as comedy, biography and autobiography, satire, allegory, the short story, the apologue, narrative poetry. May cross over the prose/poetry boundary. Maximum 6 credits. Offered as ENGL 376 and ENGL 476. Prereq: Graduate standing.

ENGL 477. Studies in Drama. 3 Units.
Readings and discussion of plays and related critical literature pertaining to a specific period in American or British drama. Topics and material will vary from semester to semester. Offered as ENGL 377 and ENGL 477. Prereq: Graduate standing.

ENGL 478. Topics in Visual and New Media Studies. 3 Units.
This course will focus on selected topics in the study of visual rhetoric and/or new media, including theoretical, critical, and historical issues raised by texts and media platforms that communicate largely through visual means or through the interaction of visual and verbal modes. Possible syllabi may focus on topics such as visual rhetoric, new media story-telling, historical perspectives on visual rhetoric and/or new media; concentrations on a particular genre (for instance, the graphic novel, video games, etc.); visual narrative; theories of new media; etc. Offered as ENGL 378 and ENGL 478. Prereq: Graduate standing.

ENGL 479. Topics in Language Studies. 3 Units.
Aspects of contemporary language studies. Topics might include history/theories of rhetoric, discourse studies, cognitive linguistics, metaphor, language acquisition, stylistics. Maximum 9 credits. Offered as ENGL 379 and ENGL 479. Prereq: Graduate standing.
ENGL 485. Special Topics in Literature. 3 Units.
Close study of a theme or aspect of literature not covered by traditional generic or period rubrics, such as "spatial imagination," "semiotics of fashion in literature," "epistolarity." Maximum 9 credits. Offered as ENGL 385 and ENGL 485. Prereq: Graduate standing.

ENGL 486. Studies in Literature and Culture. 3 Units.
Boundary-crossing study of the relations between literary and other aspects of a particular culture or society, including theoretical and critical issues raised by such study. For example, literature and medicine, law and literature, gay and lesbian literature, Asian/Western literary relations, emotion in literature, philosophy and literature, literature and music. Maximum 9 credits. Offered as ENGL 386 and ENGL 486. Prereq: Graduate standing.

ENGL 487. Literary and Critical Theory. 3 Units.
A survey of major schools and texts of literary and critical theory. May be historically or thematically organized. Maximum 6 credits. Offered as ENGL 387, WLIT 387, ENGL 487, and WLIT 487. Prereq: Graduate standing.

ENGL 501. Writing History and Theory. 3 Units.
This course addresses general research methods and theories specific to the study of writing, and functions as a required core course and overview for the Writing, History and Theory (WHiT) sequence in the English Department's Ph.D. program. Prereq: Graduate standing.

ENGL 504. Creative Writing Theory and Practice. 3 Units.
This course is designed to prepare MA and PhD candidates in English to teach ENGL 203 (Introduction to Creative Writing). It is a required course for any graduate student seeking a concentration in creative writing. The course will operate as a hybrid seminar/workshop. Students will examine and discuss traditional creative writing and teaching practices while producing their own works of creative writing for exchange and critique. Recommended Preparation: a creative writing workshop at the undergraduate or graduate level or permission of the instructor. While the overarching objective of this course is to prepare graduate students to teach ENGL 203, the multiple objectives coordinated toward that outcome are as follows: -- to exercise and refine creative writing practices of participants -- to share resources for professional development in creative writing (e.g. publication opportunities, conferences, etc.) -- to provide critical/historical view of creative writing's relationship with the academy -- to examine and debate received creative writing pedagogies -- to position creative writing in resistance to hegemony and monoculture -- to develop genre-specific, and genre-adaptable creative writing pedagogies -- to consider intersections of digital media and creative writing

ENGL 506. Professional Writing: Theory and Practice. 3 Units.
Prepares graduate students to teach disciplinary forms of writing, including technical and professional writing, in academic and non-academic settings. Prereq: ENGL 400.

ENGL 508. Seminar: English Literature 1550-1660. 3 Units.
Prereq: Graduate standing.

ENGL 510. Research Methods. 3 Units.
This course focuses on methods and resources for research in English, including substantial treatments of narrative, poetics, and close-reading skills. It also introduces graduate students to questions of textuality, genre, medium, authorship, reception, historiography, and bibliography. Prereq: Graduate standing or permission of instructor.

ENGL 517. Seminar: American Literature. 3 Units.
Prereq: Graduate standing.

ENGL 518. Seminar: English Literature 1660-1800. 3 Units.
Prereq: Graduate standing.

ENGL 519. Seminar: English Literature 1800-1900. 3 Units.
Prereq: Graduate standing.

ENGL 520. Seminar: 20th Century Literature. 3 Units.
Prereq: Graduate standing.

ENGL 521. Seminar: The Novel. 3 Units.
Prereq: Graduate standing.

ENGL 522. Seminar: Topics in Poetry. 3 Units.
Prereq: Graduate standing.

ENGL 524. Seminar: Criticism and Other Special Topics. 3 Units.
Prereq: Graduate standing.

ENGL 525. Intellectual Property and the Construction of Authorship. 3 Units.
Study of the concepts, laws, norms, and practices through which writers and other creative producers establish "property" in their work. Offered as ENGL 525 and HSTY 525. Prereq: Graduate standing or permission.

ENGL 550. External Seminar. 3 Units.
Coursework offered in cooperation with participating English departments in the region; content and approach vary. Requires prior approval of the Graduate Director.

ENGL 590. Special Reading or Research. 3 Units.
Independent study as arranged with individual instructors. Prereq: Graduate status or consent of department.

ENGL 601. Directed Reading. 1 - 6 Units.
Preparation for the Ph.D. general examination. Prereq: Graduate status.

ENGL 651. Thesis M.A.. 1 - 18 Units.
Prereq: Graduate standing.

ENGL 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Environmental Studies Program

211 A. W. Smith Building
www.case.edu/artsci/estd
Phone: 216.368.3676; Fax: 216.368.3691
Peter McCall, Program Director
peter.mccall@case.edu

Environmental studies is a multidisciplinary program that introduces students to the societal determinants and implications of environmental problems. The program emphasizes the moral, cultural, and political dimensions of environmental problems and solutions as well as scientific understanding of the environment, bringing to bear the issues and methods of the humanities and social sciences as well as those of the sciences and the professions. The program is designed to serve the needs of students seeking a liberal education or a broad intellectual base for more technical training in environmental sciences. Students can pursue a major or a minor in environmental studies.

Undergraduate Programs

Major
The Environmental Studies Program offers a major (30 credit hours) leading to the Bachelor of Arts degree. However, it may be elected only as a second major. The double major is required so that the program's multidisciplinary perspective will be complemented by a concentrated
disciplinary major. Students may apply up to six credits from required and elective courses in their first major to the environmental studies major. None of the required courses may be taken pass/no pass.

The required courses are:

### Required Courses

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ESTD 101</td>
<td>Introduction to Environmental Thinking</td>
<td>3</td>
</tr>
<tr>
<td>ESTD 398</td>
<td>Seminar in Environmental Studies</td>
<td>3</td>
</tr>
<tr>
<td>or ESTD 399</td>
<td>Departmental Seminar in Environmental Studies</td>
<td>3</td>
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</tbody>
</table>

One course from each of the following disciplinary groups:

#### Humanities

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>RLGN 206</td>
<td>Religion and Ecology</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 292</td>
<td>Energy and Environment in American History 1750-2010</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 327</td>
<td>Comparative Environmental History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 378</td>
<td>North American Environmental History</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 330</td>
<td>Topics in Ethics</td>
<td>3</td>
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#### Social Science

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<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>ESTD 303</td>
<td>Environmental Law</td>
<td>3</td>
</tr>
<tr>
<td>ESTD 388</td>
<td>Politics, Policy, and the Global Environment</td>
<td>3</td>
</tr>
<tr>
<td>ECON 368</td>
<td>Environmental Economics</td>
<td>3</td>
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#### Science and Engineering

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<th>Course</th>
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<tbody>
<tr>
<td>ESTD 202</td>
<td>Global Environmental Problems</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 351</td>
<td>Principles of Ecology</td>
<td>3</td>
</tr>
<tr>
<td>EECS 342</td>
<td>Introduction to Global Issues</td>
<td>3</td>
</tr>
</tbody>
</table>

Fifteen additional hours chosen in consultation with the departmental advisor. An approved Washington Study internship or summer field course may be used to satisfy part or all of the elective requirement. All programs of study must be approved by the director.

### Total Units

**30**

If a required course is not offered, substitution of a course to fulfill the distribution requirement is possible only with permission of the program director.

### Minor

The minor in environmental studies (15 credit hours) consists of:

#### Required course:

<table>
<thead>
<tr>
<th>Course</th>
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<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESTD 101</td>
<td>Introduction to Environmental Thinking</td>
<td>3</td>
</tr>
</tbody>
</table>

One course each from two of the following disciplinary groups:

#### Humanities

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>RLGN 206</td>
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#### Social Science

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<td>ESTD 303</td>
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<tr>
<td>ESTD 388</td>
<td>Politics, Policy, and the Global Environment</td>
<td>3</td>
</tr>
<tr>
<td>ECON 368</td>
<td>Environmental Economics</td>
<td>3</td>
</tr>
</tbody>
</table>

### Total Units

**15**

### Program Faculty

Peter L. McCall, JD, PhD  
*Professor, Department of Earth, Environmental, and Planetary Sciences; Director, Environmental Studies Program*

Timothy Beal, PhD  
*Florence Harkness Professor of Religion; Department of Religious Studies*

Jeremy Bendik-Keymer, PhD  
*Elmer G. Beamer-Hubert H. Schneider Professor in Ethics; Associate Professor, Department of Philosophy*

John Ruhl, PhD  
*Connecticut Professor, Department of Physics*

Peter Shulman, PhD  
*Associate Professor, Department of History*

Theodore Steinberg, PhD  
*Adeline Barry Davee Distinguished Professor of History, Department of History*

### Courses

#### ESTD 101. Introduction to Environmental Thinking. 3 Units.
Critical comparison of scientific, historical, religious, and literary conceptions of nature. Theories of environmental ethics, legal, and economic conceptions of environmental goods. Current controversies concerning human population growth, energy use, the consumer society, and attitudes towards animals.

#### ESTD 202. Global Environmental Problems. 3 Units.
Global Environmental Problems is a course designed to provide students with an understanding of, and an appreciation for, human-influenced environmental changes that are global in scope. Accordingly, much of the material will focus on the nature and structure of natural global systems, how and where in those systems human influences occur, and will delve deeply into a few particular problems and solutions of current interest, such as population growth, climate change, ozone depletion, and fisheries, from a variety of viewpoints. Offered as ESTD 202 and EEPS 202.
ESTD 303. Environmental Law. 3 Units.
Introduction to treatment of environmental issues in legal proceedings. Sources of environmental law, legal procedure, common law remedies (toxic torts and human health, nuisance, contract law), statutes and regulations, endangered species, public lands, toxics regulation, nuclear power, coal. The course employs the case method of reading and recitation of appellate judicial opinions. We read both classic cases in environmental law as well as current controversies. Offered as ESTD 303 and EEPS 303.

ESTD 382. Art, Eco-criticism, and the Environment. 3 Units.
As issues of sustainability and environmental impact have become increasingly dominant concerns in contemporary society, eco-criticism has emerged as a vital methodological thread across the humanities. Motivated by ethical as well as scholarly concerns, eco-criticism not only enacts a fundamental examination of nature as an ideological construct, but also seeks to investigate the complex interrelationship between humanity and the environment. Concurrently, there has been a marked interest in studying the role of “green issues” in contemporary art, particularly in tracing the development of earth art or eco-art from the early 1970s to the present. The goal of this seminar is to forge a link between these two emergent strands by tracing the complex relationship between art and the environment from the nineteenth-century to the present, seeking to thereby assess the capaciousness of eco-criticism as a methodological approach to art history. Offered as ARTH 382, ARTH 482 and ESTD 382. Counts for CAS Global & Cultural Diversity Requirement.

ESTD 388. Politics, Policy, and the Global Environment. 3 Units.
This course examines the law, politics and policy surrounding global environmental challenges such as climate change. The course aims to provide a broad overview of the key concepts, actors, debates, and issues in global environmental politics. It aims to illustrate the complexities of addressing environmental problems—from the proliferation of global institutions and international actors, to the absence of central enforcement mechanisms. We examine the causes of environmental degradation and competing views on the gravity of the problem. Using concepts from political science and economics, we investigate the challenges in getting states to act jointly to address environmental problems. We examine the actors and institutions of global environmental politics, to understand how conditions are defined as problems and responses are chosen and implemented. The course concludes by applying the tools and concepts to the case of climate change. Offered as ESTD 388, POSC 388 and POSC 488.

ESTD 398. Seminar in Environmental Studies. 3 Units.
Small group discussion and student presentations concerning the cultural determinants of environmental attitudes and policies. Each student participates in all weekly discussions and leads at least one seminar. Prereq: ESTD 101 or previous credit for ESTD 398.

ESTD 399. Departmental Seminar in Environmental Studies. 3 Units.
Discussion and critique of recent publications in Environmental Studies. Students write weekly short essays on readings and participate in weekly group discussion. Reading list changes annually and is typically comprised of 7-9 books that center on a few unifying themes for that year (food, energy, futures, toxic torts, attitudes toward animals, consumer culture, climate crises for example). Students research, write, and defend a critical review of academic literature concerning some topic contained in the readings. Prior enrollment in ESTD 101 is recommended but not required. Students may not enroll in both ESTD 398 and ESTD 399 in the same year. Counts as SAGES Departmental Seminar.

Ethnic Studies Program
207 Guilford House
www.case.edu/arts/ethnic
Phone: 216.368.2233; Fax: 216.368.2216
Cheryl Toman, Program Director
cheryl.toman@case.edu

The goal of the Ethnic Studies Program is to expand and enhance the university’s course offerings on ethnicity and race in the United States and around the world. The program’s objectives are:

1. to examine relationships among racial/ethnic groups, the processes of racial/ethnic formation, and their intersections with class, gender, and sexuality at the personal and collective levels
2. to foster the development of research skills in a broad range of disciplines in the humanities
3. to contribute to an interdisciplinary knowledge of the challenges and contributions of ethnic minorities in the United States
4. to impart to students a deep knowledge of the cultures of Africa and Latin America
5. to help students develop competencies for working with people of different racial/ethnic backgrounds and to foster an understanding of racial/ethnic diversity
6. to support students and faculty in the transmission of knowledge, in the discovery and development of new ideas, and in research and writing in the field of ethnic studies
7. to inculcate in students an understanding of the complexity and challenges of multiethnic societies, and to prepare them for careers in education, business, law, government service, social work, social welfare, health care, teaching, public policy, law enforcement, urban and community development, and the arts.

Ethnic Studies is an interdisciplinary program. The program aims to develop fundamental skills in critical and global thinking and in comparative analysis, as well as an understanding of the interactions of race, class, gender, and sexuality in the experiences of a range of social groups. It is designed to bring together a community of students, faculty, and staff devoted to the transmission of knowledge and the discovery of new ideas in the field of ethnic studies. Ethnic Studies also offers diverse perspectives that challenge monolithic thinking about the formation of identities and societies.

The program’s core courses focus on the exploration and comparison of the cultures, history, politics, and economics of Africa, Latin America, and their diasporas. Program offerings explore ethnicity and cross-cultural exchange globally and in postcolonial frames. Ethnic Studies supports research pertinent to the field and encourages cultural and academic exchange among scholars and students.

The program is part of the university’s mission to enhance the recruitment, retention, and excellence of a diverse faculty and student body. Our long-term goals are to extend program offerings to encompass other ethnic minority groups and to develop a center that will foster an appreciation of ethnic diversity and difference in the learning and research communities of Case Western Reserve University.

Undergraduate Program
Minor
The Ethnic Studies minor is open to all undergraduate students. It requires a minimum of 15 credit hours. Students are required to take
6 credits from among Ethnic Studies core courses and 9 credits in their chosen areas of concentration. Community projects are strongly recommended, and students are encouraged to carry out field research in their areas of concentration.

The core courses are designed to introduce students to the interdisciplinary field of ethnic studies. Courses may be individually or team taught and will sometimes be conducted in seminar format. Students are encouraged to use the tools and perspectives of several disciplines (history, literature, art history, anthropology, film, sociology, and political science, for example) to address the experiences of African-Americans and Latino/a Americans. Courses center on the examination of social, cultural, political, and economic structures that shape the life of these ethnic minorities in the United States. They examine how race, class, and gender have impacted their identities as well as their economic, social, political, and cultural productions. Assignments and courses make maximum use of the archives and collections of University Circle institutions.

<table>
<thead>
<tr>
<th>Required Courses:</th>
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<tbody>
<tr>
<td>ETHS 251 Perspectives in Ethnicity, Race, Religion and Gender</td>
</tr>
<tr>
<td>ETHS 252A Introduction to African-American Studies</td>
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<tr>
<td>ETHS 252B Introduction to Latina/o Studies</td>
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<tr>
<td>ETHS 253A/ HSTY 135 Introduction to Modern African History</td>
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<tr>
<td>ETHS 253B Introduction to Latin American History</td>
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Nine hours chosen from one of the concentrations listed below

<table>
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<tr>
<th>Total Units 15</th>
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<tbody>
<tr>
<td><strong>Concentrations</strong></td>
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<tr>
<td><strong>African Studies Concentration</strong></td>
</tr>
<tr>
<td>Any three of the following courses:</td>
</tr>
<tr>
<td>COSI 260 Multicultural Aspects of Human Communication</td>
</tr>
<tr>
<td>ECON 375 Economics of Developing Countries</td>
</tr>
<tr>
<td>ETHS 235 Theater and Identity</td>
</tr>
<tr>
<td>ETHS 251A Oral Performances and Ethnic Identities</td>
</tr>
<tr>
<td>ETHS 252A Introduction to African-American Studies</td>
</tr>
<tr>
<td>ETHS 394 The Subaltern and The Poetics of War in Africa</td>
</tr>
<tr>
<td>FRCH/ETHS 338 The Cameroon Experience</td>
</tr>
<tr>
<td>FRCH/WLIT 295 The Francophone World</td>
</tr>
<tr>
<td>FRCH/WLIT 308 The Paris Experience</td>
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<tr>
<td>POSC 366 Government and Politics of Africa</td>
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<tbody>
<tr>
<td><strong>African-American Studies Concentration</strong></td>
</tr>
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<td>Any three of the following courses:</td>
</tr>
<tr>
<td>COSI 260 Multicultural Aspects of Human Communication</td>
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<tr>
<td>ECON 375 Economics of Developing Countries</td>
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<tr>
<td>ENGL 365N Topics in African-American Literature</td>
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<td>ETHS 222 African-American Religions</td>
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<tr>
<td>HSTY 260 U.S. Slavery and Emancipation</td>
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<td>HSTY 261 African-American History 1865-1945</td>
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<tr>
<td>HSTY 262 African-American History Since 1945</td>
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<tr>
<td>HSTY 318 History of Black Women in the U.S.</td>
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<tr>
<th>Total Units 9</th>
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<tbody>
<tr>
<td><strong>Latin American and Caribbean Studies Concentration</strong></td>
</tr>
<tr>
<td>Any three of the following courses:</td>
</tr>
<tr>
<td>COSI 260 Multicultural Aspects of Human Communication</td>
</tr>
<tr>
<td>ECON 375 Economics of Developing Countries</td>
</tr>
<tr>
<td>POSC 364 Dictatorship and Democracy in Modern Latin America</td>
</tr>
<tr>
<td>SPAN 322 Latin American Short Story</td>
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<td>SPAN 326 The Fantastic in Latin American Prose</td>
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<td>SPAN 339 Latin American Poetic Revolt</td>
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<td>SPAN 342 Latin American Feminist Voices</td>
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<td>SPAN 343 The New Drama in Latin American</td>
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<td>SPAN 370 Special Topics in Spanish</td>
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<td>SPAN 385 Hispanic Literature in Translation</td>
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<tr>
<td><strong>Global Ethnic Studies Concentration</strong></td>
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<td>Any three of the following courses:</td>
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<td>ANTH 314 Cultures of the United States</td>
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<td>ANTH 388 Globalization, Development and Underdevelopment: Anthropological Perspective</td>
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<td>ANTH 530 Seminar in Medical Anthropology: Topics</td>
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<td>COSI 260 Multicultural Aspects of Human Communication</td>
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<td>ECON 375 Economics of Developing Countries</td>
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<td>ENGL 270 Introduction to Gender Studies</td>
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<td>ENGL/WLIT 365Q Post-Colonial Literature</td>
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<td>FRCH/WLIT 295 The Francophone World</td>
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<td>FRCH/ETHS/ WLIT/WGST 335 Women in Developing Countries</td>
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<td>POSC 362 Politics of Central Asia</td>
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<td>POSC 370K Nationalism, Ethnicity, and Religion in World Politics</td>
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<td>POSC 374 Politics of Development in the Global South</td>
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<td>WGST/ETHS 301 Women, Creativity and the Arts</td>
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| Total Units 9 |
Program Faculty

Cheryl Toman, PhD  
(University of Illinois at Urbana-Champaign)  
Professor, Department of Modern Languages and Literatures; Director, Ethnic Studies Program  
Women in Sub-Saharan Africa and the Middle East  
Katia Almeida, PhD  
Instructor, Department of Anthropology  
Latin America and Brazil, globalization and electronic technologies in higher education  
Damaris Punales-Alpizar, PhD  
(University of Iowa)  
Associate Professor, Department of Modern Languages and Literatures  
Latin American studies  
Joy Bostic, PhD  
(Union Theological Seminary)  
Associate Professor, Department of Religious Studies  
African-American religion and culture  
M. Gabriela Copertari, PhD  
(Georgetown University)  
Associate Professor, Department of Modern Languages and Literatures  
Latin American literature and film  
Gilbert Doho, PhD  
(University of Paris—Sorbonne Nouvelle)  
Associate Professor, Department of Modern Languages and Literatures; Founding Director, Ethnic Studies Program  
African theater and film, people theater  
Marilyn Sanders Mobley, PhD  
(Case Western Reserve University)  
Professor, Department of English; Vice President for Inclusion, Diversity, and Equal Opportunity  
African-American literature  
Jacqueline Nanfito, PhD  
(UCLA)  
Associate Professor, Department of Modern Languages and Literatures  
Latin American studies / Women’s studies  
Cristián Gómez Olivares, PhD  
(University of Iowa)  
Assistant Professor, Department of Modern Languages and Literatures  
Latin American literature and theory  
Jonathan Tan, PhD  
(Catholic University of America)  
Archbishop Paul J. Hallinan Professor in Catholic Studies; Associate Professor, Department of Religious Studies  
Asian/Asian American Studies and Chinese/Chinese American Studies

Courses

ETHS 153. Introducing Chinese Religions. 3 Units.  
This "topics" course offers an introduction to the academic study of Chinese religions. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and a basic religious literacy in the nuances and complexities in Chinese religions within various historical and socio-cultural contexts. Section topics might include, but are not limited to: Confucianism, Daoism, Chinese Buddhism, Gender and Sexuality in Chinese Religions. Students may repeat the course for credit once (two times total for 6 credits), provided that the two sections are different. Offered as RLGN 153, ETHS 153 and CHIN 253. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 218. Jews in Early Modern Europe. 3 Units.  
This course surveys the history of Jews in Europe and the wider world from the Spanish expulsion through the French Revolution. Tracking peregrinations out of the Iberian Peninsula to the British Isles, France, Holland, Italy, Germany, Poland-Lithuania, the Ottoman Empire, and the American colonies, it examines the diverse ways Jews organized their communities, interacted with their non-Jewish neighbors, and negotiated their social, economic, and legal status within different states and empires. What role did Jews play and what symbolic place did they occupy during a period of European expansion, technological innovation, artistic experimentation, and religious and political turmoil? What internal and external dynamics affected Jewish experiences in the sixteenth, seventeenth, and eighteenth centuries? Through a selection of inquisitorial transcripts, government records, memoirs, and historical literature, we will explore topics such as persecution, conversion, messianism, toleration, emancipation, and assimilation. Offered as HSTY 218, JDST 218, and ETHS 218. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 220. The Early Modern Mediterranean. 3 Units.  
For centuries before Columbus crossed the Atlantic Ocean, travelers and traders, pirates and pilgrims, mercenaries and missionaries explored the contours of the Mediterranean Sea—and engaged in commerce, as well as religious, economic and military competition. If religion and ethnicity divided Muslims, Christians and Jews from Algiers to Athens, did shared geography, foodstuffs, and cultural values bind them together? This course examines the unity and diversity of this maritime region by considering the peoples, beliefs, commodities and diseases that circulated through it during the sixteenth, seventeenth, and eighteenth centuries. Does the early modern Mediterranean showcase a clash of civilizations or provide an enduring model for coexistence? Topics include merchant culture, diplomacy, honor and shame, slavery and colonization. Offered as ETHS 220 and HSTY 220. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 222. African-American Religions. 3 Units.  
This course is an exploration of the rich diversity of African American religions from the colonial period to the present. Attention will be given to key figures, institutional expressions, and significant movements in African American religious history. Major themes include African traditions in American religions, slavery and religion, sacred music, social protest, Black Nationalism in religion, Islam, African American women and religion, and black and womanist theologies. Course requirements will include field trips to local religious sites. Offered as ETHS 222 and RLGN 222.
ETHS 224. The Many Faces of Contemporary U.S. Catholicism. 3 Units.
This course explores the implications of immigration and changing demographics on the contemporary U.S. Catholic Church. The course investigates the diverse racial and ethnic communities that increasingly define U.S. Catholicism and includes a particular focus on Africans and African Americans, Latina/os, and Asian Americans. Attention will be given to the intersections of faith, ethnicity, race, and identity constructions in contemporary U.S. Catholicism, as well as issues of racism and racial justice in the U.S. Catholic Church and other social, cultural, and political dynamics that are shaping and transforming contemporary Catholic identities in the United States. Offered as ETHS 224 and RLLG 224. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 232. DESI: Diaspora, Ethnicity, Southasia(n), Interrogate. 3 Units.
In this class we will interrogate the cultural identity(ies) and imagined community(ies) of the "South Asian" Diaspora. We will first examine taxonomy and categorization itself, as a methodological, philosophical, and political enterprise. We will then examine how such contrived categories have been applied to the so-called desis, loosely and broadly understood as members of the South Asian Diaspora. To this end we will scrutinize the development of American(ized) "Hinduism." The imagined location that desis have in North American racial and ethnic hierarchies, and the construction of assimilated, enculturated, and transnational imagined desi communities. Offered as RLLG 232 and ETHS 232. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 234. France and Islam. 3 Units.
This seminar examines French encounters with the Muslim world from the Middle Ages to the present. Over the last millennium, France has viewed Saracens, Moriscos, Turks, Berbers, and Arabs with admiration and fear, disdain and incomprehension. Between the eleventh and thirteenth centuries, French soldiers battled in the Holy Land; for several hundred years after that, France and the Ottoman Empire exchanged diplomats, traders and slaves. The colonial occupation of Algeria that began in 1830 ended violently in 1962. By then, the empire that struck back had also come home through large waves of immigration. Today, the social and economic status, religious affiliation, political significance and cultural impact of French citizens of North African descent are the subject of burning national debate. Taking a long view on Franco-Muslim relations, the course will explore such topics as the Crusades, Mediterranean piracy and captivity, Napoleon's Egyptian campaign, the Algerian War of Independence, the "veil affair" riots in the suburbs of Paris and World Cup soccer. Offered as ETHS 234 and HSTY 234. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 235. Theater and Identity. 3 Units.
This course aims at surveying identities in dramatic and performance texts in the modern era. It will help students develop skills to study plays and related theatrical forms, to analyze images for their social and political meanings, to investigate issues of identity, to appreciate the complexities of identity and images of self and other as related in theater, media and the larger political and social contests. African and African-American identities, Latina/o-American and Latin American identities, Native-American identities, Asian-American and Asian identities, Gender identities will be examined.

ETHS 251. Perspectives in Ethnicity, Race, Religion and Gender. 3 Units.
This course is designed to introduce students to the study of ethnicity. Basic concepts such as race, gender, class, and identity construction will be examined. Students are encouraged to use the tools and perspectives of several disciplines to address the experiences of ethnic groups in the United States. Offered as ETHS 251 and RLLG 251. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 251A. Oral Performances and Ethnic Identities. 3 Units.
This course is an in-depth study of performances that have helped to shape and anchor the identities of different non-Western ethnic groups. The course will explore the multi-generic composition of the oral epic, which combines forms as diverse as narrative, song, praise poetry, theater, music and historical oratory. ETHS 251A will provide a comprehensive overview of oral performances while focusing on a particular area or areas of Africa, Asia, the United States, or Latin America. In the African continent, for example, the focus will be on the Madinka Sundjata corpus, dealing with the empire of Mali; the life of Shaka, the Zulu in South Africa; while in the United States, the narrative life of Frederick Douglass, blue-songs peoples will be considered as the sites of ethnic discourse. Using a comparative approach, the course will examine aesthetic issues of oral performance, the written word, interactions between music and voice, and interaction between poetic and prose narrative forms. The performance texts will be augmented by field recordings and in-class demonstrations by griots and other storytellers from Africa and the United States.

ETHS 252A. Introduction to African-American Studies. 3 Units.
This course is designed to introduce students to the study of Black History, cultures, economics, and politics. Students will learn about the development of the field by exploring theoretical questions, methodological approaches, and major themes that have shaped the study of black people, primarily in the U.S. context. This is a seminar-style, discussion-based course that emphasizes critical analysis and expository writing. Offered as ETHS 252A and HSTY 252A. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 252B. Introduction to Latina/o Studies. 3 Units.
Interdisciplinary introduction to the basis for a Latina/o ethnicity through an exploration of commonalities and differences in the peoples of Latin American and Caribbean origin within the continental United States. Topics include methodological and theoretical formulations central to the field (e.g., racial, gender, and sexual formations, modes and relations of production and class, nation and transnation), history and contemporary issues of identity, family, community, immigration, and the potential for a pan-ethnic identity. Discussions will focus on major demographic, social, economic and political trends: historical roots of Latinas/os in the U.S.; the evolution of Latina/o ethnicity and identity; immigration and the formation of Latina/o communities; schooling and language usage; tendencies and determinants of socioeconomic and labor force status; discrimination, segregation and bias in contemporary America; racial and gender relations; and political behavior among Latinas/os. Offered as: ETHS 252B and HSTY 259. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 253A. Introduction to Modern African History. 3 Units.
A general introduction to major themes in modern African history, with an emphasis on the nineteenth and twentieth centuries. Topics include oral tradition and narrative, economic structure and dynamics, religious movements, colonialism, nationalism, and the dilemmas of independent African states. Offered as ETHS 253A and HSTY 135. Counts for CAS Global & Cultural Diversity Requirement.
ETHS 253B. Introduction to Latin American History. 3 Units.
This course provides an introduction to the historical and cultural development of Latin America, in an attempt to identify the forces, both internal and external, which shape the social, economic and political realities in present day Latin America. Beginning with its pre-Columbian civilizations, the course moves through the conquest and colonial period of the Americas, the wars of independence and the emergence of nation-states in the nineteenth century, and the issues confronting the region throughout the turbulent twentieth century, such as migration and urbanization, popular protest and revolution, environmental degradation, great power intervention, the drug trade and corruption, and the integration of the region into the global economy. Offered as ETHS 253B and HSTY 136. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 254. The Holocaust. 3 Units.
This class seeks to answer fundamental questions about the Holocaust: the German-led organized mass murder of nearly six million Jews and millions of other ethnic and religious minorities. It will investigate the origins and development of racism in modern European society, the manifestations of that racism, and responses to persecution. An additional focus of the course will be comparisons between different groups, different countries, and different phases during the Nazi era. Offered as ETHS 254 and HSTY 254. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 258. History of Southern Africa. 3 Units.
A survey of southern Africa from about 1600. Topics include the social structure of pre-colonial African societies, the beginnings of European settlement, the rise of Shaka, the discovery of minerals and the development of industry, Zimbabwe's guerrilla war and independence, and the rise and apparent demise of apartheid. Offered as ETHS 258 and HSTY 258. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 260. U.S. Slavery and Emancipation. 3 Units.
 Begins with the African encounter with Europeans during the emergence of the modern slave trade. Students are introduced to the documents and secondary literature on the creation and maintenance of slavery, first in colonial America, and then in the United States. The course concludes with the destruction of slavery. Offered as ETHS 260 and HSTY 260. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 261. African-American History 1865-1945. 3 Units.
Explores the fashioning of a modern African-American culture between emancipation and the end of World War II. Emergence of a northern-based leadership, the challenge of segregation, emergence of bourgeois culture, the fashioning of racial consciousness and black nationalism, the shift from a primarily southern and rural population to one increasingly northern and urban, the creation and contours of a modern African-American culture, the construction of racial/gender and racial/class consciousness. Offered as ETHS 261 and HSTY 261. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 262. African-American History Since 1945. 3 Units.
Completes the three-term sequence of the African-American history survey (although the first two courses are not prerequisites for this course). Explores some of the key events and developments shaping African-American social, political, and cultural history since 1945. Offered as HSTY 262 and ETHS 262. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 265. Malcolm and Martin. 3 Units.
An examination of the lives, religious thought, and ideological frameworks of Malcolm X and Martin Luther King, Jr. The course will investigate Malcom X and Martin King's religious beliefs and activist strategies; the ideas and strategies of other civil rights and Black Nationalist leaders who influenced and challenged Martin and Malcom's ideas on race, gender, class, and sexuality; and the historical antecedents for these strategies within nineteenth-century black religious, social, and political movements. Their impact on modern African American religious thought, American political culture, and international human rights movements will also be explored. Offered as ETHS 265 and RLGN 265. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 280. History of Modern Mexico. 3 Units.
This course explores the major issues that have influenced the formation of modern Mexico. This class is organized around three major themes. First, we will examine Mexican identity formation and its political implications. Second, we will assess Mexican life in relation to the development of the Mexican economy. Finally, we will survey how elite and popular forms of violence have affected Mexican society. Throughout the course, we will discuss the significance of the colonial heritage, regional distinctions, racial and gender stratification, and the creation and reconfiguration of various types of borders. Offered as HSTY 280 and ETHS 280. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 295. The Francophone World. 3 Units.
The course offers an introduction to the Francophone World from a historical, cultural, and literary perspective. The Francophone World includes countries and regions around the globe with a substantial French-speaking population (and where French is sometimes, but not always, an official language): North America (Louisiana, Quebec, and Acadia); North Africa (Tunisia, Morocco, Algeria, and Egypt); the Middle-East (Lebanon, Syria); the Caribbean (Martinique, Guadeloupe, Haiti); Southeast Asia (Vietnam); and Europe (France, Belgium, Switzerland, and Luxembourg). FRCH 295 provides a comprehensive overview of the Francophone World, while focusing on a particular area or areas in any given semester. Offered as ETHS 295, FRCH 295, and WLIT 295.

ETHS 301. Women, Creativity and the Arts. 3 Units.
In this course, students will focus on two areas of study: a) women and creativity and b) women and activism through the arts. A history of women in the arts will be covered, but the general focus of the course is on women in the arts since the 1960s in particular, and on artwork that reflects or provokes social change. "Arts" are defined in the broadest sense. That is, students will study women's production in painting, photography, graphic design, sculpture, dance, film, music, and theater. A variety of learning techniques will be applied: Students will look at feminist theories on art, be introduced to the notion of cyberfeminism, study actual artwork and its reproductions, understand the role of art in feminist activism and how women "create" differently from men, and work closely with several feminist artists/activists through various programs on campus and the community in order to facilitate the planning and carrying out of artistic production. Subsequently, students will interact with children in Cleveland schools in conjunction with these artists giving master classes, and be exposed to art exhibits abroad through videoconferencing with the Algerian Cultural Center in Paris and locally through University Circle Institutions. Offered as WGST 301 and ETHS 301. Counts for CAS Global & Cultural Diversity Requirement.
ETHS 302. The Lemonade Class: Religion, Race, Sex and Black Music. 3 Units.
Charles Long suggests that black musical forms are creative responses to the particular circumstances of black peoples' presence in the U.S. and black notions of the sacred. In April of 2016, Beyoncé released her visual album Lemonade two days after the death of Prince. This course is organized around the album’s title cuts and links these two artists together in an examination of religion and musical performance as creative response to the racial and gendered conditions of black life. The course investigates how both artists have used music as a platform to explore issues of race, gender, commerce, sexuality, power and divinity. The course also looks at examples from the works of earlier artists who address similar themes such as Ma Rainey, Bessie Smith, Muddy Waters, Billie Holiday, Nina Simone, Little Richard, James Brown, Marvin Gaye, and Aretha Franklin. Offered as ETHS 302, MUHI 316, RLGN 302, RLGN 402, and WGST 302. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 304. Representations of Black Women and Religion in Film. 3 Units.
In this course we will explore cinematic representations of black women and religion in film. Each week we will view a film in class. We will begin the class with the film Imitation of Life and then the course with The Help. Throughout the course we will analyze the ways in which notations of gender, sexuality, intimate violence, and modern notions of race and color, have informed representations of black women and religion in film. In addition, we will discuss how these representations, in turn, have influenced cultural ideas about black women in the Americas. Offered as RLGN 304, RLGN 404, WGST 304, and ETHS 304. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 306. The Cuban Experience: an immersion in its culture and society. 3 Units.
This is a three week study-abroad intensive course that takes place at Editorial Vigía, in Matanzas, Cuba. The course combines the unique advantages of a total immersion environment in Spanish with a classroom curriculum that includes conversation practice and study of relevant cultural, literary and historical issues. Students complete three hours of classroom instruction and an hour and a half of publishing workshop four days per week. In this workshop, they work in the edition of a bilingual book. In addition, they participate in organized visits to historic sites and museums connected to the culture curriculum. The focus of the culture curriculum is the study of Cuban history and culture through its literature, visual arts, films, and music. After applying and being accepted in the program, students meet for personal advising with the program director and attend four different one hour orientation-information meetings in the spring semester. After successful completion of the study-abroad program, students receive 3 upper-level credits in Spanish. The course is interdisciplinary in approach and provides students with the tools they need to analyze and understand the complexities of modern Cuba. Students will have formal classes taught by their professor and talks and meetings with specialists on Cuban literature, art, architecture, history and other aspects of culture and society. In addition, they will attend lectures, participate in discussions, and take field trips that will expose them to many aspects of Cuban culture, such as art, architecture, music, dance, film, literature, artisan work, folklore, history and urban growth. Offered as SPAN 306, SPAN 406, and ETHS 306. Prereq: SPAN 202.

ETHS 307. Body, Health and Medicine in Chinese Religions: Historical and Contemporary Perspectives. 3 Units.
This course critically evaluates the history and development of traditional Chinese approaches to health and medicine in the context of Chinese religious, philosophical, and socio-cultural history. It examines the constructions of the body in Chinese religious and philosophical thought across different historical periods and evaluates their significance and implications for understanding Chinese approaches to health and medicine. It discusses the conceptions of "health" and "good health" in ancient China, the distinction between "healing" and "curing," the development of the complementary yin-yang and five phases (wuxing) theories, understandings of nature (xing) and body (ti), the concept of qi as life force, and various microcosm-macrocosm analogies that emerged from Chinese religious and philosophical traditions. It explores how these religious and philosophical frameworks, beginning with the Daoist classic, Basic Questions in the Inner Classic of the Yellow Emperor (Huangdi Neijing Suwen) have evolved to undergird the development of diet, acupuncture, moxibustion, meditation, and various alchemical practices within Chinese holistic conceptions of health and practices of Traditional Chinese Medicine. Offered as RLGN 307, RLGN 407, CHIN 307, HSTY 308, and ETHS 307. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 311. Representations of Black Religion in Film. 3 Units.
In this course we will explore cinematic representations of black religion in the Americas and the Caribbean. Each week we will view a film representing diverse religious traditions such as Christianity, Candomble, Santeria, Vodou, and Islam. Films will include Cabin in the Sky, The Color Purple, Black Orpheus, The Serpent and the Rainbow, Malcolm X, Eve's Bayou, and The Princess and the Frog. Throughout the course we will analyze the ways in which notions of gender, the history of colonialism, modern notions of race, and geographical landscapes have informed representatives of black religion in film. In addition, we will discuss how these representations, in turn, have influenced cultural ideas of black religion in the Americas. Offered as RLGN 304, ETHS 311, and RLGN 411. Counts for CAS Global & Cultural Diversity Requirement. Prereq: RLGN 222 or ETHS 251 or ENGL 367 or by permission of Instructor.

ETHS 314. Cultures of the United States. 3 Units.
This course considers the rich ethnic diversity of the U.S. from the perspective of social/cultural anthropology. Conquest, immigration, problems of conflicts and accommodation, and the character of the diverse regional and ethnic cultures are considered as are forms of racism, discrimination, and their consequences. Groups of interest include various Latina/o and Native peoples, African-American groups, and specific ethnic groups of Pacific, Mediterranean, European, Asian, and Caribbean origin. Offered as ANTH 314, ETHS 314, and ANTH 414.

ETHS 316. African Political Thought. 3 Units.
Introduction to select themes in the work of contemporary African philosophers, with special emphasis on political thought. In this course, students will learn something about factors affecting the creation and flow of knowledge and ideas about Africa and discuss the relative importance of the "nation-state" as an idea in Europe, pre-colonial Africa, and postcolonial Africa. Offered as PHIL 316, ETHS 316, PHIL 316, and ETHS 416. Counts for CAS Global & Cultural Diversity Requirement. Prereq: PHIL 101.

ETHS 318. History of Black Women in the U.S.. 3 Units.
Chronologically arranged around specific issues in black women's history organizations, participation in community and political movements, labor experiences, and expressive culture. The course will use a variety of materials, including autobiography, literature, music, and film. Offered as ETHS 318, HSTY 318, and WGST 318.
ETHS 325. Hispanic Intellectuals and Society: A Critical Approach. 3 Units.
This course offers an overview of the most important critical approaches to Spanish American culture and literature, with a socio-historical emphasis. Some of the authors we will discuss are Angel Rama, Jose Antonio Cornejo Polar and Nestor Garcia Canclini. We will analyze how the Latin American intellectuals have thought about specific issues such as identity, race, ideology, colonial and post-colonial relations with the metropolis and the process of formation of the nations in the continent. The class, the discussions, exams, oral presentations and papers will be in Spanish. Some of the readings must be in English, but most of them will be in Spanish. Offered as SPAN 325, SPAN 425, ETHS 325, WLIT 325 and WLIT 425. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 326. Christianity in China. 3 Units.
This course critically evaluates Christianity’s long history in China, beginning with the “Luminous Religion” (Jingjiao) that was propagated by Assyrian Christian missionaries in Tang China (7th century CE), the missionary endeavors of Catholic and Protestant foreign missionaries and mission societies, the rise of indigenous Chinese Christianities that sought independence from foreign missionaries, the impact of communist rule and the Cultural Revolution, and current developments involving both the official government-approved churches (i.e., the Three Self Patriotic Movement and the Chinese Patriotic Catholic Association) on the one hand, and the house church movement (jiating jiaohui) on the other hand. Students will critically discuss and analyze the historical dimensions of Christianity’s presence in China and engagement with various social, cultural, political, philosophical, and religious aspects of Chinese society, past and present, and consider the implications of emergent forms of contemporary indigenous Chinese Christian movements for the future of Chinese Christianity. Offered as RLGN 316, RLGN 416, HSTY 322, CHIN 316 and ETHS 326. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 333. Contemporary Caribbean Literature. 3 Units.
In addition to developing a general familiarity with the literature and history of this region, students will acquire an awareness of the interrelation of national identity, memory, and language in the texts produced by contemporary Caribbean authors, and of the cultural hybridity characteristic of this production. The themes treated by these authors include colonialism and postcolonialism, cultural and religious syncretism, and sexual politics. Offered as SPAN 333, SPAN 433, ETHS 333, WLIT 333 and WLIT 433. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 335. Women in Developing Countries. 3 Units.
This course will feature case studies, theory, and literature of current issues concerning women in developing countries primarily of the French-speaking world. Discussion and research topics include matriarchal traditions and FGM in Africa, the Tunisian feminist movement, women, Islam, and tradition in the Middle East, women-centered power structures in India (Kerala, Pondicherry), and poverty and women in Vietnam, Laos, and Cambodia. Guest speakers and special projects are important elements of the course. Seminar-style format, taught in English, with significant disciplinary writing in English for WGST, ETHS, and some WLIT students, and writing in French for FRCH and WLIT students. Writing assignments include two shorter essays and a substantial research paper. Offered as ETHS 335, FRCH 335, WLIT 335, WGST 335, FRCH 435 and WLIT 435. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 337. Women in the Arab World. 3 Units.
The purpose of this course is twofold: It is a course that allows students an in-depth look at the diverse women who represent a number of cultures in the Arab world in nations from the Mashrek to the Maghreb. The second primary goal of the course is to study such women through the eyes of leading Arab women theorists who have made an impact not only in their own countries, but also on disciplines intersecting with women’s studies worldwide. We will study the Arab woman’s place in her respective society, in political and economic systems, in education, and in the family. We will also analyze her contributions to art and literature as well as to the sciences. The course will provide an overview of the Arab woman throughout history, from her origins to her place within recent movements within the Arab Spring and other current world events. As Arab women are Muslim, Christian, and Jewish, views of women within these major world religions will also be taken into account as we study the Arab woman as well as religion’s impact on culture in the Middle East and in the Maghreb in particular. In the course, we will utilize theoretical texts, but also case studies as well as examples from media and the arts. During the semester, we will take advantage of teleconferencing opportunities between CWRU and two major academic units for Women’s Studies in the Arab world: The Institute for Women’s Studies in the Arab World (IWSAW) in Beirut, Lebanon, and the University of Jordan’s Center for Women’s Studies in Amman. Offered as FRCH 337, FRCH 437, ARAB 337, ETHS 337 and WGST 337. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 338. The Cameroon Experience. 3 Units.
Three-week immersion learning experience living and studying in Cameroon. The focus of the course is the culture, literature, and language of Francophone Cameroon, with some emphasis on Anglophone Cameroon. Students spend a minimum of fifteen hours per week visiting cultural sites and attending arranged courses at the University of Buea. Students will prepare a research paper. Coursework is in French. To do coursework in English, students should enroll in WLIT 338/438 or ETHS 338/438. Offered as ETHS 338, FRCH 338, WLIT 338, ETHS 438, FRCH 438, and WLIT 438. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 339. Black Women and Religion. 3 Units.
This course is an exploration of the multidimensional religious experiences of black women in the United States. These experiences will be examined within particular historical periods and across diverse social and cultural contexts. Course topics and themes include black women and slave religion, spirituality and folk beliefs, religion and feminist/ womanist discourse, perspectives on institutional roles, religion and activism, and spirituality and the arts. Offered as ETHS 339, RLGN 338 and WGST 339. Counts for CAS Global & Cultural Diversity Requirement.
ETHS 340. A History of Workers in the United States. 3 Units.
This course examines the experience of working people in the United States with an emphasis on twentieth-century social movements. It explores the lives of the women and men, skilled and unskilled, and rural and urban laborers that produce the goods and provide the services that society consumes. At crucial moments, working people have created or helped sustain national social movements in an effort to improve some aspect of their lives. We therefore will assess laborers in relation to several known and less known American social movements, such as the eight-hour day movement during the late nineteenth century, the peace movement during WWI, and the Civil Rights movement in the wake of WWII. Throughout the course we will also discuss the politics of time-managed work; the influence of public policy and government institutions; the role of unions within a competitive market economy; the relationship between industrial economies and functional blue-collar communities; and the correlation between immigration and globalization. Offered as HSTY 340, HSTY 430 and ETHS 340. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 342. Latin American Feminist Voices. 3 Units.
Examination of the awakening of feminine and feminist consciousness in the literary production of Latin American women writers, particularly from the 1920s to the present. Close attention paid to the dominant themes of love and dependency; imagination as evasion; alienation and rebellion; sexuality and power; the search for identity and the self-preservation of subjectivity. Readings include prose, poetry, and dramatic texts of female Latin American writers contributing to the emerging of feminist ideologies and the mapping of feminist identities. Offered as SPAN 342, SPAN 442, ETHS 342, WGST 342, WLIT 342, and WLIT 442.

ETHS 343. The New Drama in Latin American. 3 Units.
Representative works of contemporary Latin American drama. Critical examination of selected dramatic works of twentieth-century Latin America provides students insight into the nature of drama and into the structural and stylistic strategies utilized by Latin American dramatists to create the "new theater," one which is closely related to Latin American political history. Offered as SPAN 343, SPAN 434, ETHS 343, WLIT 343 and WLIT 434. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 349. The Arab World Experience. 3 Units.
Taught and led by Case faculty, The Arab World Experience is a spring semester course with a spring break study abroad component in a Middle Eastern or North African country supplemented by course meetings before and after travel. It will rotate among countries such as Jordan, Lebanon, Morocco, etc. and be taught by faculty with appropriate area expertise in Arabic, Women’s and Gender Studies, and/or Ethnic Studies. The course focuses on topics such as history, politics, culture, and gender relations within the society of study. Workload and learning outcomes are commensurate with a semester-long three credit hour course. Guest lectures in the host country are an important component of the course as they bring a fresh, authentic perspective to the aforementioned topics discussed. There will be three three-hour meetings prior to travel, required reading, and one three-hour meeting after travel. In the host country, students will spend seven days (five-eight hours per day) in seminars, discussions, and site visits. Student grades are determined on the basis of participation, attendance, a daily experiential learning journal, interviews with guest speakers, and a final exam. Offered as ARAB 349, ETHS 349 and WGST 349. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 352. African Feminisms. 3 Units.
This course traces the history of African feminism from its origins within traditions through to a more contemporary theoretical analysis of gender, marriage, and motherhood seen from a Afrocentric perspective. Approaches studied are those that pertain to anthropology, history, literature, sociology, and culture. African feminist theory of scholars such as Filomena Steady, Cheikh Anta Diop, Buchi Emecheta, Ifi Amadiume, Obioma Nnameka, Oyeronko Owewumi, and Calixthe Beyala will be studied and there will be some comparative analysis of Western theories to show how African feminisms are clearly distinct. Theories on these feminisms will be presented, and in the process, students will look at cases of women in Cameroon, Nigeria, Ghana, Kenya, and Senegal. It is commonly believed that African women were defined for a long time according to constructs of Western anthropology. This course will thus look at social institutions such as woman-to-woman marriage, matriarchy, and various women’s rituals in order to identify African constructs of gender, family, kinship, marriage, and motherhood. Offered as ETHS 352 and WGST 352. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 356. Afro-Hispanic Literature. 3 Units.
This course will survey the literary and cultural production of writers and artists of African descent in Latin America and the Caribbean, paying attention to both their creative and theoretical texts. Discussion of questions of race and ethnicity will allow students to explore the ways in which these texts reformulate the idea of national identity and cultural belonging in the context of the nation-state, whose traditional centrality is being weakened through the effects of migration and exile. Readings include works by writers from Cuba, Puerto Rico, Dominican Republic, Costa Rica, Colombia, Panama, Ecuador, and Peru. Offered as SPAN 356, SPAN 456, ETHS 356, WLIT 356 and WLIT 456. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 358. Latin American Cinema. 3 Units.
This course is designed to introduce students to the basic tools of film analysis as well as to the major trends and movements in Latin American cinema from the 1960s to the present. Through the analysis of representative films from Latin America, the course will examine the development of a variety of cinematic styles, paying particular attention to the historical contexts in which the films were produced and to the political, cultural, and aesthetic debates that surrounded their production. Offered as SPAN 358, SPAN 458, ETHS 358, WLIT 358 and WLIT 458. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 362. Politics of Central Asia. 3 Units.
Once an unfamiliar region to many people of the world, Central Asia took center stage in the fall of 2001 as a result of the U.S. campaign against terrorism. This course will introduce students to the politics of Central Asia, focusing on the region today composed of Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, and Kazakhstan. We will review the nationalism, foreign relations, religion, ethnicity, and economics of the region. Offered as ETHS 362, POSC 362, and POSC 462. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 363H. African-American Literature. 3 Units.
A historical approach to African-American literature. Such writers as Wheatley, Equiano, Douglass, Jacobs, DuBois, Hurston, Hughes, Wright, Baldwin, Ellison, Morrison. Topics covered may include slave narratives; African-American autobiography, the Harlem Renaissance, the Black Aesthetic, literature of protest and assimilation. Maximum 6 credits. Offered as ENGL 363H, ETHS 363H, WLIT 363H, ENGL 463H, and WLIT 463H. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.
ETHS 364. Dictatorship and Democracy in Modern Latin America. 3 Units.
Examination of political leadership in 20th-century Latin America, exploring the nature of populism in the 1930s and 1940s, to the end of democracy and establishment of military regimes in the 1960s and 1970s, and ultimately to the contemporary processes of democratization and economic liberalization. Offered as ETHS 364, POSC 364, and POSC 464. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 365N. Topics in African-American Literature. 3 Units.
Selected topics and writers from nineteenth, twentieth, and twenty-first century African-American literature. May focus on a genre, a single author or a group of authors, a theme or themes. Maximum 6 credits. Offered as ENGL 365N, ETHS 365N, WLIT 365N, ENGL 465N, and WLIT 465N. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ETHS 365Q. Post-Colonial Literature. 3 Units.
Readings in national and regional literatures from former European colonies such as Australia and African countries. Maximum 6 credits. Offered as ENGL 365Q, ETHS 365Q, WLIT 365Q, ENGL 465Q, and WLIT 465Q. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

ETHS 366. Government and Politics of Africa. 3 Units.
Comparative analysis of the political forces and organizations currently functioning in Africa, as well as a survey of the formal government institutions. Special emphasis on single-party rule, military rule, and the political ramifications of African socialism, tribalism and the problems of national integration. Offered as ETHS 366, POSC 366, and POSC 466.

ETHS 369. Ethnicity, Gender, and Religion in Latin American Politics and Society. 3 Units.
This course focuses on aspects of Latin America’s social and political realities and dilemmas. It will first explore race, gender, and religion, and then tackle revolution, democracy and populism. Throughout, the entire region's history, geography, and culture(s) will be considered; for example, the European and indigenous legacies in Mexico and Peru, Bolivia, Chile, and Ecuador; the Asian presence in Peru and Brazil; the African contributions to Cuba and Brazil, female heads of state, such as Nicaragua's Violeta Chamorro, Chile's Michelle Bachelet, Argentina's Cristina Fernandez de Kirchner, Costa Rica’s Laura Chinchilla, and Brazil's Dilma Rousseff. The class will explore Liberation Theology and the new Pope's worries about the declining number of Catholics in the region. Today's multiparty democracy in Mexico, Hugo Chavez's 14-year rule in Venezuela, and Cuba's international humanitarian aid would not be possible without revolution(s) and populism. They are intertwined with ethnicity, gender, and religion. Offered as ETHS 369, POSC 369 and POSC 469. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 370K. Nationalism, Ethnicity, and Religion in World Politics. 3 Units.
Examination of the post-Cold War surge in conflicts among nationalisms, ethnic groups, and religions with particular attention to the former Yugoslavia, Ireland, India, Africa, and the Middle East. Offered as ETHS 370K, POSC 370K, and POSC 470K.

ETHS 374. Politics of Development in the Global South. 3 Units.
Exploration of the post-World War II emergence of the Global South nations of Africa, Asia, the Middle East, Latin America, and the Eastern Europe arena. Offered as ETHS 374, POSC 374, and POSC 474.

ETHS 375. Hispanic Literature in Translation. 3 Units.
Critical analysis and appreciation of representative literary masterpieces from Spain and Latin America, and by Hispanics living in the U.S. Texts cover a variety of genres and a range of literary periods, from works by Cervantes to those of Gabriel Garcia Marquez. The course will examine the relationship between literature and other forms of artistic production, as well as the development of the Hispanic literary text within the context of historical events and cultural production of the period. Counts toward Spanish major only as related course. No knowledge of Spanish required. Offered as ETHS 375, ETHS 485, SPAN 385, SPAN 485, WLIT 385, and WLIT 485.

ETHS 391. Advanced Readings in Black History. 3 Units.
This is an advanced readings course that may change from semester to semester. This course will provide students with an opportunity to more deeply explore special themes and theoretical issues in the field of black history that are often quickly and briefly covered in broad survey courses. Readings may be organized around specific topics such as resistance and social protest, black intellectual history, black nationalism and identity, black film and historical literacy black cultural forms and politics, black urban history, or some other combination. Students may take this course more than once and receive credit as long as the course topic differs. Students should contact the History Department for more details on course content during any given semester. Offered as ETHS 391, HSTY 399 and HSTY 499.

ETHS 393. Advanced Readings in the History of Race. 3 Units.
This course examines the concept of race as a social construction that carries political and economic implications. We begin by examining the histories of the early racial taxonomists (e.g., Bernier, Linnaeus, and Blumenbach among others) and the contexts that informed their writings. We then assess how the concept of race changed from the nineteenth to the twentieth century in the United States. We conclude by evaluating how the ideology of race has influenced U.S. domestic life and foreign policy at specific historical moments. Offered as HSTY 393, HSTY 493, and ETHS 393. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 394. The Subaltern and The Poetics of War in Africa. 3 Units.
This course is a seminar on major war writers and filmmakers in Africa such as Chinua Achebe, Ngugi wa Thiongo, Emmanuel Dongola, Iweala Uzodinma, Ismael Beah, Sembene Ousmane, Ingrid Sinclair etc. Students will be asked to use postcolonial theory to critically read and view films and texts on war in Africa. They will engage in discussion with guest scholars in the field of African studies. In addition to a final research paper, students are also required to write short papers on selected books and films read and/or viewed during the semester.

ETHS 399. Independent Study. 0 - 3 Units.
This course focuses on topics in ethnicity. In consultation with the program director and instructors, students pick topics in their concentrations and make a list of books and films for personal and intensive reading. Some of these projects might be Arts and Identity in post-independent Africa [African Concentration], films, literatures and human rights in Latin America [Latin America and Caribbean Concentration], civil rights through music and songs [African-American Concentration] etc. Travel may be a component of this course depending on the nature of the students' interests. Weekly reports are required for the instructors to measure the students' progress.
ETHS 416. African Political Thought. 3 Units.
Introduction to select themes in the work of contemporary African philosophers, with special emphasis on political thought. In this course, students will learn something about factors affecting the creation and flow of knowledge and ideas about Africa and discuss the relative importance of the "nation-state" as an idea in Europe, pre-colonial Africa, and postcolonial Africa. Offered as PHIL 316, ETHS 316, PHIL 316, and ETHS 416. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 438. The Cameroon Experience. 3 Units.
Three-week immersion learning experience living and studying in Cameroon. The focus of the course is the culture, literature, and language of Francophone Cameroon, with some emphasis on Anglophone Cameroon. Students spend a minimum of fifteen hours per week visiting cultural sites and attending arranged courses at the University of Buea. Students will prepare a research paper. Coursework is in French. To do coursework in English, students should enroll in WLIT 338/438 or ETHS 338/438. Offered as ETHS 338, FRCH 338, WLIT 338, ETHS 438, FRCH 438, and WLIT 438. Counts for CAS Global & Cultural Diversity Requirement.

ETHS 485. Hispanic Literature in Translation. 3 Units.
Critical analysis and appreciation of representative literary masterpieces from Spain and Latin America, and by Hispanics living in the U.S. Texts cover a variety of genres and a range of literary periods, from works by Cervantes to those of Gabriel Garcia Marquez. The course will examine the relationship between literature and other forms of artistic production, as well as the development of the Hispanic literary text within the context of historical events and cultural production of the period. Counts toward Spanish major only as related course. No knowledge of Spanish required. Offered as ETHS 385, ETHS 485, SPAN 385, SPAN 485, WLIT 385, and WLIT 485.

Evolutionary Biology Program
217 Rockefeller, Institute for the Science of Origins
www.case.edu/artsci/evolutionarybiology
Phone: 216.368.4257
Patricia Princehouse, Program Director
patricia.princehouse@case.edu

The Evolutionary Biology Program is designed to provide students with knowledge of macro- and micro-evolutionary processes underlying the evolution and diversification of life on Earth and an understanding of the meta-scientific issues involved in this unique field of study.

The program includes grounding in the history and philosophy of evolutionary thought and alternative conceptualizations of the mechanisms, patterns, and processes of evolution. It emphasizes evolutionary theory, foundations of ecology and genetics, focused study of particular organisms or groups of organisms, and the dynamics of evolutionary principles in scientific inquiry.

Undergraduate Programs

Major
Evolutionary biology is a second major, to be pursued in conjunction with a conventional disciplinary major. Up to 12 credits in required and elective courses taken by students for their first major may be applied to their evolutionary biology major.

The 30-credit interdisciplinary major in evolutionary biology consists of:

1. Three foundation courses
2. One course in ecology
3. One course in the philosophy/history of science
4. Four approved electives

The approved electives may include additional philosophy/history of science courses from the list below. In consultation with a major advisor, students will tailor intensive study to suit particular interests within the major.

Required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIL 214</td>
<td>Genes, Evolution and Ecology</td>
<td>3</td>
</tr>
<tr>
<td>EEPS 210</td>
<td>Earth History, Tectonics, Climate, and Life</td>
<td>3</td>
</tr>
<tr>
<td>PHIL/ANTH/BIOL/ EEPS/HSTY 225</td>
<td>Evolution</td>
<td>3</td>
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</tbody>
</table>

Additional required courses (one from each area)

Ecology

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIL 216</td>
<td>Development and Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 336</td>
<td>Aquatic Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 351</td>
<td>Principles of Ecology</td>
<td>3</td>
</tr>
</tbody>
</table>

Philosophy/History of Science

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSTY 201</td>
<td>Science in Western Thought I</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 202</td>
<td>Science in Western Thought II</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 402</td>
<td>Introduction to Historiography of Science</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 203</td>
<td>Revolutions in Science</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 303</td>
<td>Topics in Philosophy of Science</td>
<td>3</td>
</tr>
</tbody>
</table>

Approved electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ANTH 103</td>
<td>Introduction to Human Evolution</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 302</td>
<td>Darwinian Medicine</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 370</td>
<td>Field Seminar in Paleoanthropology</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 375</td>
<td>Human Evolution: The Fossil Evidence</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 377</td>
<td>Human Osteology</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 378</td>
<td>Reproductive Health: An Evolutionary Perspective</td>
<td>3</td>
</tr>
<tr>
<td>BIL 214L</td>
<td>Genes, Evolution and Ecology Lab</td>
<td>3</td>
</tr>
<tr>
<td>BIL 216L</td>
<td>Development and Physiology Lab</td>
<td>3</td>
</tr>
<tr>
<td>BIL 223</td>
<td>Vertebrate Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 305</td>
<td>Herpetology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 318</td>
<td>Introductory Entomology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 326</td>
<td>Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIL 328</td>
<td>Plant Genomics and Proteomics</td>
<td>3</td>
</tr>
<tr>
<td>BIL 339</td>
<td>Aquatic Biology Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>BIL 343</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 345</td>
<td>Mammal Diversity and Evolution</td>
<td>3</td>
</tr>
<tr>
<td>BIL 351L</td>
<td>Principles of Ecology Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>BIL 358</td>
<td>Animal Behavior</td>
<td>3</td>
</tr>
<tr>
<td>BIL 362</td>
<td>Principles of Developmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 363</td>
<td>Experimental Developmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 364</td>
<td>Research Methods in Evolutionary Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIL 365</td>
<td>Evo-Devo: Evolution of Body Plans and Pathologies</td>
<td>3</td>
</tr>
</tbody>
</table>
EEPS 301  Stratigraphy and Sedimentation
EEPS/BIOL 307  Evolutionary Biology and Paleobiology of Invertebrates
PSCL 350  Behavior Genetics
STAT 201  Basic Statistics for Social and Life Sciences
STAT 313  Statistics for Experimenters
EECS 458  Introduction to Bioinformatics
ANTH/EEPS/PHIL 367  Topics in Evolutionary Biology
ANTH/BIOL/EEPS/PHIL 396  Undergraduate Research in Evolutionary Biology

Total Units  27

**Minor**
The 15-credit interdisciplinary minor consists of three foundation courses and two approved electives. In consultation with a minor advisor, students will tailor intensive study to suit their particular interests.

**Required courses:**
- BIOL/ANTH/EEPS/HSTY/PHIL 225 Evolution (3 hours)
- BIOL 214 Genes, Evolution and Ecology (3 hours)
- EEPS 210 Earth History: Time, Tectonics, Climate, and Life (3 hours)

Two approved electives selected in consultation with advisor (6 hours)

Total Units  15

**Program Faculty**
Patricia Princehouse, PhD
*Senior Research Associate, Department of History; Director, Evolutionary Biology Program*

Radhika Atit, PhD
*Professor, Department of Biology*

Cynthia M. Beall, PhD
*Distinguished University Professor and Sarah Idell Pyle Professor of Anthropology, Department of Anthropology*

Michael Benard, PhD
*Associate Professor, Department of Biology*

Darin Croft, PhD
*Associate Professor, Department of Anatomy, School of Medicine*

Yohannes Haile-Selassie Ambaye, PhD
*Adjunct Professor, Department of Anthropology; Curator and Head of Physical Anthropology, Cleveland Museum of Natural History*

Emmitt Jolly, PhD
*Associate Professor, Department of Biology*

Bruce Latimer, PhD
*Adjunct Professor of Anthropology; Adjunct Associate Professor, Department of Anatomy, School of Medicine*

Peter McCall, JD, PhD
*Professor, Department of Earth, Environmental, and Planetary Sciences*

Scott Simpson, PhD
*Associate Professor, Department of Anatomy, School of Medicine*

Mark Willis, PhD
*Professor and Chair, Department of Biology*

Peter A. Zimmerman, PhD
*Professor, Center for Global Health and Diseases, School of Medicine*

**French and Francophone Studies Program**
203 Clark Hall
http://www.case.edu/artsci/fr_studies/
Phone: 216.368.2633; Fax: 216.368.6078

Designed to develop cross-cultural awareness and to foster international understanding, the French and Francophone Studies (FFS) Program adds an exciting dimension to the traditional liberal arts curriculum. The French and Francophone Studies major differs from the traditional French major in two respects: its interdisciplinary nature and its greater flexibility in accommodating students’ areas of interest. The FFS major answers the needs of students with a strong interest in cultural issues in general and in French and Francophone history and society in particular. By allowing students to take course work in English, the FFS major allows them to profit from the many courses in various departments that focus on France and the Francophone world.

The FFS Program is an interdisciplinary, integrated program that understands the term “French” in its broadest sense. It thus reflects the diversity of the field of French studies, which explores varied cultures of Francophone expression: Canada, the Caribbean, North and West Africa, the Middle East, and Southeast Asia. Reaching beyond disciplinary and national boundaries, the program encourages students to choose from a large selection of courses in the humanities, the arts, and the social sciences. In this way, it provides both a meaningful course of study and an outstanding preparation for graduate or professional schools and for careers in international business and finance, law, journalism, diplomatic service, nonprofit and other international organizations, health, teaching, or the arts.

**Undergraduate Programs Major**
Each student prepares a program of study in close consultation with a faculty advisor drawn from the advisory committee. Students should also discuss their choice of a minor or a second major with their advisor.

French and Francophone Studies (FFS) majors should demonstrate French language ability by completing French 201-202 or the equivalent. They will also take at least one 300-level FRCH course (see Foundations in Culture courses below).

The major in French and Francophone Studies requires a minimum of 33 credit hours in the following areas:

**1. Foundations in Language (8 hours)**
For students entering at the 200-level of French language:
- FRCH 201  Intermediate French I (4 hours)
- FRCH 202  Intermediate French II (4 hours)
Students entering at the 300-level of language study complete 21 credits in courses from the Electives section below.

<table>
<thead>
<tr>
<th>Total Units</th>
<th>8</th>
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</thead>
</table>

2. Foundations in Culture: Introduction to French and Francophone cultures (9 hours)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRCH/WLIT 295</td>
<td>The Francophone World</td>
<td>3</td>
</tr>
<tr>
<td>Two of the following:</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>FRCH 316</td>
<td>Contemporary France</td>
<td></td>
</tr>
<tr>
<td>FRCH 318</td>
<td>The Origins of France</td>
<td></td>
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<tr>
<td>FRCH 319</td>
<td>Modern France</td>
<td></td>
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<tr>
<td>HSTY 310</td>
<td>The French Revolutionary Era</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Units</th>
<th>9</th>
</tr>
</thead>
</table>

3. Electives: Related Courses in French and Other Disciplines (15-21 hours)

Students select from courses that focus on French and Francophone cultures in FRCH and other disciplines (art history, political science, history, etc.). These are chosen from the approved list (see below) and in conjunction with a program advisor. No more than 9 of these credits may be chosen from FRCH courses.

<table>
<thead>
<tr>
<th>Anthropology</th>
<th>ANTH 399</th>
<th>Independent Study</th>
<th>1 - 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art History</td>
<td>ARTH 260</td>
<td>Art in Early Modern Europe</td>
<td>3</td>
</tr>
<tr>
<td>ARTH 280</td>
<td>Modern Art and Modern Science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ARTH 284</td>
<td>History of Photography</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ARTH 340</td>
<td>Issues in the Art of China</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ARTH 374</td>
<td>Impressionism to Symbolism</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ARTH 379</td>
<td>Issues in 19th Century Art</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ARTH 392</td>
<td>Issues in 20th/21st Century Art</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ARTH 398</td>
<td>Independent Study in Art History</td>
<td>1 - 3</td>
<td></td>
</tr>
<tr>
<td>Economics</td>
<td>ECON 372</td>
<td>International Finance</td>
<td>3</td>
</tr>
<tr>
<td>ECON 373</td>
<td>International Trade</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ECON 375</td>
<td>Economics of Developing Countries</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>ENGL/WLIT 290</td>
<td>Masterpieces of Continental Fiction</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 301</td>
<td>Linguistic Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGL 368C</td>
<td>Topics in Film Capstone</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGL 379</td>
<td>Topics in Language Studies</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGL/WLIT 387</td>
<td>Literary and Critical Theory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>HSTY 151</td>
<td>Technology in European Civilization</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 201</td>
<td>Science in Western Thought I</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 202</td>
<td>and Science in Western Thought II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 215</td>
<td>Europe in the 20th Century</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 234</td>
<td>France and Islam</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 250</td>
<td>Issues and Methods in History</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 309/RLGN 374</td>
<td>Reformation Europe, 1500-1650</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 310</td>
<td>The French Revolutionary Era</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY/RLGN 315</td>
<td>Heresy and Dissidence in the Middle Ages</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 332</td>
<td>European International Relations 1789-1945</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY/POSC 348</td>
<td>History of Modern Political and Social Thought</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>HSTY 397</td>
<td>Undergraduate Tutorial</td>
<td>1 - 3</td>
<td></td>
</tr>
<tr>
<td>International Studies</td>
<td>INTL 396</td>
<td>International Independent Study</td>
<td>1 - 3</td>
</tr>
<tr>
<td>Music</td>
<td>MUHI 301</td>
<td>History of Western Music I</td>
<td>3</td>
</tr>
<tr>
<td>MUHI 302</td>
<td>History of Western Music II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MUHI 303</td>
<td>History of Western Music III</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Philosophy</td>
<td>PHIL 302</td>
<td>Modern Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 315</td>
<td>Selected Topics in Philosophy</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 325</td>
<td>Philosophy of Feminism</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PHIL 399</td>
<td>Philosophy Honors Thesis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Political Science</td>
<td>POSC 326</td>
<td>Constitutions in Practical Politics</td>
<td>3</td>
</tr>
<tr>
<td>POSC/HSTY 348</td>
<td>History of Modern Political and Social Thought</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>POSC 351</td>
<td>Modern Political Thought</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>POSC 366</td>
<td>Government and Politics of Africa</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>POSC 367</td>
<td>Western European Political Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>POSC 370A</td>
<td>Political Economy</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>POSC 373</td>
<td>Politics of the European Union</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>POSC 374</td>
<td>Politics of Development in the Global South</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>POSC 395</td>
<td>Special Projects</td>
<td>1 - 6</td>
<td></td>
</tr>
<tr>
<td>Religious Studies</td>
<td>RLGN/HSTY 315</td>
<td>Heresy and Dissidence in the Middle Ages</td>
<td>3</td>
</tr>
<tr>
<td>RLGN 374/HSTY 309</td>
<td>Reformation Europe, 1500-1650</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>RLGN 392</td>
<td>Independent Study</td>
<td>1 - 3</td>
<td></td>
</tr>
<tr>
<td>Theater</td>
<td>THTR 329</td>
<td>Modern and Contemporary Drama</td>
<td>3</td>
</tr>
<tr>
<td>THTR 399</td>
<td>Independent Study in Theater Arts</td>
<td>1 - 3</td>
<td></td>
</tr>
<tr>
<td>World Literature</td>
<td>WLIT 211</td>
<td>World Literature I</td>
<td>3</td>
</tr>
<tr>
<td>WLIT 212</td>
<td>World Literature II</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WLIT/ENGL 290</td>
<td>Masterpieces of Continental Fiction</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WLIT 300</td>
<td>The City in Literature</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WLIT 390</td>
<td>Topics in World Literature</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>WLIT 399</td>
<td>Independent Study</td>
<td>1 - 3</td>
<td></td>
</tr>
</tbody>
</table>

Courses offered in a given semester with a French and Francophone Studies component are posted in Guilford House at registration time and on the French and Francophone Studies (http://www.case.edu/artsci/fr_studies) website.
Study Abroad
Study abroad in France, Belgium, Switzerland, French Canada, the Francophone Caribbean, or a Francophone African or Middle Eastern country is strongly encouraged but not required for FFS majors. The Department of Modern Languages and Literatures offers a summer study abroad program in Paris (FRCH 308 The Paris Experience / WLIT 308 The Paris Experience) in even-numbered years. A summer study abroad program in Cameroon (FRCH 338 The Cameroon Experience / WLIT 338 The Cameroon Experience / ETHS 338 The Cameroon Experience) is offered in odd-numbered years. FRCH 208 The Montreal Experience is a spring break service-learning excursion to Montreal.

Minor
The minor requires 15-17 credits. Students entering at the 200 level of language competence take:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRCH 201</td>
<td>4</td>
</tr>
<tr>
<td>FRCH 202</td>
<td>4</td>
</tr>
<tr>
<td>Three courses in FRCH from the approved list</td>
<td>9</td>
</tr>
<tr>
<td>Total Units</td>
<td>17</td>
</tr>
</tbody>
</table>

At least 6 credits should be taken in disciplines other than FRCH. Students entering at the 300 level of language competence take five courses at the 200 and 300 levels in FRCH and from the approved list. At least 3 credits should be in courses from FRCH taught in the French language, and at least 6 credits should be taken in disciplines other than FRCH.

Program Advisory Committee
Gilbert Doho, PhD
Associate Professor, Department of Modern Languages and Literatures
Laura E. Hengehold, PhD
Associate Professor, Department of Philosophy
Marie Lathers, PhD
Elizabeth M. and William C. Treuhaft Professor of Humanities, Department of Modern Languages and Literatures
Miriam R. Levin, PhD
Henry Eldridge Bourne Professor of History, Department of History
Cheryl Toman, PhD
Professor, Department of Modern Languages and Literatures

Affiliated faculty
Gillian Weiss, PhD
Associate Professor, Department of History

German Studies Program
112/113 Clark Hall
Phone: 216.368.4144; Fax: 216.368.4681
Kenneth F. Ledford and Susanne Vees-Gulani, Program Co-Directors

In its reconstituted form, Germany has again become a major player in European and global affairs. Germany has always been considered important to European development—at various times it has been called the crossroads of the entire continent—but the economic might of modern Germany and the integration of the European Union have now made American understanding of German culture and civilization more important to—and worthy of study by—American students than at any time since 1945.

German Studies, an integrated program of study leading to the BA degree, offers students the freedom to develop an interdisciplinary sequence of courses to meet their particular needs and interests. It builds the foundation for graduate work in many academic fields that call for a thorough knowledge of German language, culture, and history. It also prepares students for careers in international business or for future study in professional programs such as law and business administration.

After graduation, many German and German Studies majors (most of whom have a second major in another field) visit Germany to study or work. Our majors have returned to Germany on Fulbright scholarships, through internships administered by the Carl-Duisberg-Gesellschaft, or as interns for the German parliament.

Undergraduate Programs
Major
The major in German Studies, which includes a German language requirement, concentrates on the study of the German cultural tradition in history, philosophy, the fine arts, music, film studies, politics, and culture. The major is particularly suited to students wishing to combine interests in German language and culture with a major in another discipline.

The major requires 30 hours, to be distributed as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRMN 303</td>
<td>3</td>
</tr>
<tr>
<td>GRMN 311</td>
<td>3</td>
</tr>
<tr>
<td>GRMN 396</td>
<td>3</td>
</tr>
<tr>
<td>Twenty-one additional hours approved by one of the co-directors, with no more than 9 hours from any one department</td>
<td>21</td>
</tr>
<tr>
<td>Total Units</td>
<td>30</td>
</tr>
</tbody>
</table>

Possible concentrations for the German Studies major include history and philosophy; German literature and theater history; political science and history; art history; music history; and religious studies. Within the program requirements, students are free to shape the major as they wish, based on their own intellectual interests.

Minor
The course requirements for the minor (15 hours) are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One of the following:</td>
<td>3</td>
</tr>
<tr>
<td>GRMN 303</td>
<td>German Culture &amp; Civilization</td>
</tr>
<tr>
<td>GRMN 311</td>
<td>Advanced Conversation</td>
</tr>
<tr>
<td>Four additional 300-level courses approved by one of the co-directors</td>
<td>12</td>
</tr>
<tr>
<td>Total Units</td>
<td>15</td>
</tr>
</tbody>
</table>

Gerontological Studies Program
226 Mather Memorial
www.case.edu/artsci/soci/gerontological.html
Phone: 216.368.2703; Fax: 216.368.2676
Dale Dannefer and Gary Deimling, Program Co-Directors
The Gerontological Studies Program is a multidisciplinary program designed to integrate research and theory about human aging and human development over the life course.

Rapidly occurring social change is compelling social scientists, policymakers, human service professionals, and others to focus on aging as both an individual and global force. Beyond the rapid graying of the world’s population, other frontiers of change include knowledge developments in the biosocial domain (epigenetic and other types of gene-environment interaction), powerful trends in the political and economic spheres (e.g., cumulative dis/advantage, pension policy, generational equity), and cultural changes (e.g., the development of forward-thinking institutional arrangements and the growth of the anti-aging industry).

Courses are drawn from three departments: Anthropology, Psychological Sciences, and Sociology. Students may choose from a variety of courses according to their own interests. Some approved elective courses are not specifically gerontology courses but cover topics that contribute to the understanding of aging and the life course. The perspectives gained in the core courses will provide the student with the background needed to relate the material in the more general courses to gerontological issues. The program is firmly grounded in the liberal arts and thus provides the student with the challenge to think and communicate effectively and to integrate diverse information, theories, and practice.

Gerontological Studies is an appropriate major or minor for students with a wide variety of career goals. Persons with baccalaureate degrees in this field are eligible for entry-level positions in organizations that provide services to older people and that formulate policy related to aging and older adults. Many graduate and professional training programs now include an emphasis on aging for which a degree in Gerontological Studies would serve as useful preparation. Students planning to pursue professional degrees will find that an increasing number of their clients or patients will be older adults and that problems with which they must deal are related to aging. The perspective provided by participating in the Gerontological Studies Program provides students with excellent background for working with older populations.

Gerontological Studies faculty members are engaged in a variety of funded research projects. These include studies of Alzheimer’s disease; cancer survivorship; health disparities and cumulative dis/advantage over the life course; patterns of care for the elderly; visual perception changes that accompany aging; the impact of high levels of physical activity on the biological aging process; grandparent-grandchild relationships; and stress, coping, and adaptation among institutionalized older adults and elderly residents of urban communities.

**Undergraduate Programs**

**Major**

The interdisciplinary program in Gerontological Studies offers a major as part of the Bachelor of Arts degree. Gerontological Studies may be selected only as a second major, since the primary major must be based in a traditional academic department. The major consists of a minimum of 24 credits; 9 are in required core courses and 21 are in approved elective courses.

**Required core courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSI 345</td>
<td>Communication and Aging</td>
</tr>
<tr>
<td>PSCL 369</td>
<td>Adult Development and Aging</td>
</tr>
<tr>
<td>SOCI 369/469</td>
<td>Aging in American Society (or)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTH 215</td>
<td>Health, Culture, and Disease: An Introduction to Medical Anthropology</td>
</tr>
<tr>
<td>SOCI 311</td>
<td>Health, Illness, and Social Behavior</td>
</tr>
<tr>
<td>SOCI 313</td>
<td>Sociology of Stress and Coping</td>
</tr>
<tr>
<td>SOCI 319</td>
<td>Sociology of Institutional Care</td>
</tr>
<tr>
<td>SOCI 361</td>
<td>The Life Course</td>
</tr>
<tr>
<td>SOCI 365</td>
<td>Health Care Delivery</td>
</tr>
<tr>
<td>SOCI 369/469</td>
<td>Aging in American Society (or)</td>
</tr>
</tbody>
</table>

Total Units: 30

**Minor**

Students may also elect a minor in Gerontological Studies. The minor requires a minimum of 15 credit hours, including at least two of the following five courses.

**At least two of the following:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSI 345</td>
<td>Communication and Aging</td>
</tr>
<tr>
<td>PSCL 369</td>
<td>Adult Development and Aging</td>
</tr>
<tr>
<td>SOCI 361</td>
<td>The Life Course</td>
</tr>
<tr>
<td>SOCI 369/469</td>
<td>Aging in American Society (or)</td>
</tr>
</tbody>
</table>

* The remaining nine hours needed to fulfill the minor requirement may consist of any combination of the approved electives and core courses listed for the Gerontological Studies major.

Total Units: 15

**Graduate Certificate Program in Gerontology**

University Center on Aging and Health
1420 Frances Payne Bolton School of Nursing
Phone: 368-2692; Fax: 216-368-6389
Diana L. Morris, PhD, RN, FAAN, FGSA, Executive Director diana.morris@case.edu

The University Center on Aging and Health (https://nursing.case.edu/ucah) is dedicated to the premise that aging is a developmental process spanning the entire life cycle, and brings together social and behavioral sciences, health sciences, and the humanities to encourage teaching and research activities in every unit of the university. The Center sponsors a certificate program in gerontology for graduate and professional students and for those who already hold graduate degrees.

A student interested in a graduate certificate in gerontology must be enrolled in a master’s or doctoral program, or be a special non-degree student with at least a master’s degree (or equivalent). To receive a certificate in gerontology, a student must submit a formal application, be approved by the University Center on Aging and Health, and take 12 credit hours of course work.

The student must complete the following courses:

1. Two 3-credit courses in gerontology within the student’s discipline, one of which can be an independent study.
2. One 3-credit course in gerontology or independent study outside the student’s discipline.
3. A 3-credit seminar in gerontology offered by the center.

Any departures from the requirements must be approved by the center director. For further information, contact the University Center on Aging and Health.

Program Faculty

Dale Dannefer, PhD  
(Rutgers University)  
Professor, Department of Sociology; Co-Director, Gerontological Studies Program  
Medical sociology; sociology of aging; family sociology

Atwood Gaines, PhD (University of California), MPH (Berkeley)  
Professor, Department of Anthropology  
Medical and psychiatric anthropology; cultural studies of science and medicine; cultural bioethics; religion; aging and dementia; social identity and health

Brian Gran, PhD (Northwestern University), JD (Indiana University-Bloomington)  
Associate Professor, Department of Sociology  
Sociology of law; comparative sociology; health care policy; human rights

Eva Kahana, PhD (University of Chicago)  
Distinguished University Professor and Pierce T. and Elizabeth D. Robson Professor of the Humanities, Department of Sociology  
Sociology of aging; medical sociology; social factors in stress and coping

Jessica Kelley-Moore, PhD (Purdue University)  
Associate Professor, Department of Sociology  
Health disparities; sociology of disability; sociology of the life course; race/ethnicity

Todd McCallum, PhD (University of Southern California)  
Associate Professor, Department of Psychological Sciences  
Older adults; caregiving; ethnicity; stress and coping

Courses

GERO 498. Seminar in Gerontological Studies. 3 Units.  
Major themes in gerontology. Seminar members choose a problem area, explore the relevant literature from a multi-disciplinary perspective, and develop a research project using knowledge gained through community observation and library exploration.

GERO 601. Independent Study. 1 - 3 Units.  
For students enrolled in the graduate certificate program in gerontology.

The Department of History offers comprehensive undergraduate and graduate programs in all fields of history, with particular strengths in American history; the history of science, technology, environment, and medicine; and social history and policy. Historical studies are sometimes categorized among humanistic studies and sometimes among the social sciences. Allied with both traditions, historians seek an understanding of the past by analyzing societies and how they change over time.

The Department of History offers instruction within the customary frameworks that have formed the basis of historical studies, and it also has developed special emphases in social, cultural, political, and economic perspectives that allow instruction and research on such topics as the African-American experience, the environment, business and economy, technology and science, medicine, women's history and gender studies, legal history, and comparative social history. Courses in history, or a formal major or minor in history, traditionally have been attractive to students as preparation for a wide variety of career and professional interests, including teaching, law, government, medicine, and journalism, and such public history activities as archival administration, historical museum administration, restoration and preservation of historic sites, and writing.

Facilities

Case Western Reserve University, the other institutions in University Circle, and the Cleveland area in general offer excellent facilities for historical research. These facilities are especially strong in the fields of social history and policy and in the history of medicine, health care, nonprofit organizations, technology, and science. The university library's extensive collections in these fields are significantly augmented by the holdings of the nationally ranked Allen Memorial Library in the history of medicine and health care, and of the equally distinguished Western Reserve Historical Society in regional economic, social, nonprofit, ethnic, African-American, and Jewish history. Both the Allen Memorial Library and the Western Reserve Historical Society library are adjacent to the campus. The Cleveland Public Library, just five miles from campus in downtown Cleveland, is the third largest public library in the U.S.; it maintains excellent research collections in Ohio, U.S., and British history, technology, and business. The university has also pioneered the development of electronic connections to other libraries and to research resources in general; Ohio's many colleges and universities have one of the nation's leading interlibrary loan programs.

Undergraduate Programs

Major

The history major may be elected in one of two formats: the regular major or the teacher licensure major.

Regular Major

The regular major requires a minimum of 30 hours in history courses, including:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSTY 113</td>
<td>Introduction to Modern World History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 250</td>
<td>Issues and Methods in History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 398</td>
<td>Senior Research Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

The remaining seven electives must include one course in U.S. history, one course in pre-modern history, and one course each in at least 2 other, different geographical areas. Each course can only fulfill one requirement.
These distribution requirements are new and replace the old requirement that each student have a “concentration” of four related courses.

**Teacher Licensure Program**

The teacher education major for licensure in Integrated Social Studies (Adolescence to Young Adult) requires 30 hours of history, including the same four courses required for the regular major and a minimum of six semester hours in each of three focus areas: United States history, world/European studies, and Asian, African, and Latin American studies. Candidates for teacher licensure must also take courses in economics, political science, and sociology (9 hours) and 36 hours in education courses, culminating in student teaching. Students interested in pursuing this option should confer with the department’s undergraduate advisor. See the Teacher Licensure (p. 522) section in this bulletin.

**Subject area requirements:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSTY 103</td>
<td>Introduction to Medieval History, 500-1500</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 105</td>
<td>Introduction to Modern European History, 1750-present</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 112</td>
<td>Introduction to American History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 113</td>
<td>Introduction to Modern World History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 250</td>
<td>Issues and Methods in History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 398</td>
<td>Senior Research Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

Two of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSTY 152</td>
<td>Technology in America</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 206</td>
<td>Ancient and Medieval Spain: Prehistory to 1492</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 255</td>
<td>Economic History of the United States</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 256</td>
<td>American Political History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 257</td>
<td>Immigrants in America</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 260</td>
<td>U.S. Slavery and Emancipation</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 262</td>
<td>African-American History Since 1945</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 325</td>
<td>U.S. Politics, Culture, and Society: 1790-1860</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 353</td>
<td>Women in American History I</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 354</td>
<td>Women in American History II</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 355</td>
<td>Age of American Civil War 1815-80</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 378</td>
<td>North American Environmental History</td>
<td>3</td>
</tr>
</tbody>
</table>

Two of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSTY 151</td>
<td>Technology in European Civilization</td>
<td>3</td>
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<tr>
<td>HSTY 254</td>
<td>The Holocaust</td>
<td>3</td>
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<tr>
<td>HSTY 309</td>
<td>Reformation Europe, 1500-1650</td>
<td>3</td>
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<tr>
<td>HSTY 310</td>
<td>The French Revolutionary Era</td>
<td>3</td>
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<tr>
<td>HSTY 334</td>
<td>History of 19th Century Germany</td>
<td>3</td>
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<tr>
<td>HSTY 335</td>
<td>History of 20th Century Germany</td>
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Two of the following:

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>HSTY 135</td>
<td>Introduction to Modern African History</td>
<td>3</td>
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<tr>
<td>HSTY 137</td>
<td>Introduction to Modern South Asia</td>
<td>3</td>
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<tr>
<td>HSTY 138</td>
<td>Radical History in America</td>
<td>3</td>
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<tr>
<td>HSTY 157</td>
<td>Women’s Histories in South Asia</td>
<td>3</td>
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<td>HSTY 163</td>
<td>Modern Britain and Its Empire</td>
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<td>HSTY 193</td>
<td>The Ancient World</td>
<td>3</td>
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<tr>
<td>HSTY 232</td>
<td>Gods and Gladiators: The World of Ancient Rome</td>
<td>3</td>
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<tr>
<td>HSTY 252A</td>
<td>Introduction to African-American Studies</td>
<td>3</td>
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<tr>
<td>HSTY 259</td>
<td>Introduction to Latina/o Studies</td>
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<tr>
<td>HSTY 270</td>
<td>Introduction to Gender Studies</td>
<td>3</td>
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<tr>
<td>HSTY 280</td>
<td>History of Modern Mexico</td>
<td>3</td>
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<tr>
<td>HSTY 339</td>
<td>The Origins of the Arab-Israeli Conflict, 1900-1948</td>
<td>3</td>
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<tr>
<td>HSTY 356</td>
<td>Industrial America: 1880-1940</td>
<td>3</td>
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<tr>
<td>HSTY 358</td>
<td>America Since 1940</td>
<td>3</td>
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<tr>
<td>HSTY 363</td>
<td>Gender and Sexuality in America</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 383</td>
<td>Readings in PRC History</td>
<td>3</td>
</tr>
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One of the following:

- ECON 102 Principles of Microeconomics
- ECON 103 Principles of Macroeconomics
- POSC 160 Introduction to Comparative Politics

One of the following:

- SOCI 101 Introduction to Sociology
- SOCI 113 Critical Problems in Modern Society
- SOCI 310 The Individual in Society

**Total Units** 81

(With advisor approval, the sociology requirement may be met with HSTY 262 African-American History Since 1945 or HSTY 325 U.S. Politics, Culture, and Society: 1790-1860, and the political science requirement may be met with HSTY 256 American Political History.)

**Integrated Graduate Studies**

The Department of History participates in the Integrated Graduate Studies (IGS) Program (p. 1078). Interested students should note the general requirements and procedures of the School of Graduate Studies, but they must also consult the departmental advisor about the specific requirements, guidelines, and opportunities for IGS in history.

**Minor**

The history minor will consist of five courses (15 credit hours) in history. At least one course must be above the 100-level. Minor advisors will encourage students to take courses across a variety of fields. Elective courses can be chosen from all HSTY courses. The history minor is available to all undergraduate students.

**Advanced Placement Credit**

Beginning with the Fall 2016 semester, the History Department no longer accepts AP credit.

**Graduate Programs**

The Department of History offers both the MA and the PhD in history. Many, but not all, of our PhD students work within one of the department’s two focused PhD programs: (1) Social History and Policy, and (2) History of Science, Technology, Environment and Medicine. In practice, these two programs are often closely related. The department also joins with the Law School to offer an MA/JD dual-degree program. Applicants for graduate degrees in history must submit transcripts from all previous undergraduate, graduate, and professional study;
scores on the GRE or a comparable standardized test; three letters of recommendation; application essays; and a writing sample.

Master of Arts
The MA in history requires 27 hours of course work, including 6 hours of carefully supervised work on a master's thesis (a work of original research based on primary sources). For the joint JD/MA program, students must be admitted to both the history graduate program and the law school. They can earn the degree in either three and one-half years or three years and two summers of study, completing a total of 106 hours (including double credits of up to nine hours).

Doctor of Philosophy
Students are admitted into the history department's graduate programs with or without a master's or professional degree. Students who do not have a master's degree in history will generally be required to complete that degree in the department before moving on to the PhD; those who have earned graduate or professional degrees closely related to their PhD programs may petition for direct admission to the PhD program. Students who first complete their MA in history at Case Western Reserve must complete an additional 24 hours of course work, pass the qualifying exams required by their program of study, and prepare a PhD dissertation while enrolling in at least 18 hours of supervised dissertation-writing work. Students who have completed their master's-level work before coming to Case Western Reserve must complete at least 24 hours of course work before taking their qualifying exams and proceeding to their dissertation. All PhD students are required to take:

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<tr>
<th>Course Code</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>HSTY 470</td>
<td>Historiography, Method, and Theory</td>
<td>3</td>
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<tr>
<td>HSTY 476</td>
<td>Seminar in Comparative History</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 479</td>
<td>Historical Research and Writing</td>
<td>3</td>
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Social History and Policy Program (SHP)
The Social History and Policy Program is designed to prepare students for careers either as analysts and administrators of social policy or as teachers and researchers in colleges and universities. The program defines social policy broadly to include not only welfare, family and juvenile matters, aging, health care, and medicine, but also education, urban history, environmental history, cultural policies regarding museums, libraries and similar agencies, and labor. The program recognizes that social policies are made and put into practice by private, nonprofit organizations and through legal institutions as well as through federal, state, and local legislatures and executives.

Entry into the program does not require an MA in history; several students have been admitted with JD, MSW, library science, or other degrees. However, the program often requires students with limited backgrounds in U.S. history to take extra course work.

More tightly structured than the traditional PhD, the Social History and Policy Program requires 18 hours of course work (and possibly additional hours to prepare for examinations); qualifying examinations in U.S. history and in the history of social policy; a cognate field; and a dissertation. The program also includes an option for the student to complete a policy-related internship. In the past, internships have been conducted with the Cleveland Federation for Community Planning, the Interchurch Council of Greater Cleveland, the Bureau of Jewish Education, the Sisters of Charity of St. Augustine, and the Hathaway Brown School.

History of Science, Technology, Environment and Medicine Program (STEM)
The History of Science, Technology, Environment and Medicine Program was established in 1961 as the first in the nation to emphasize the history of technology as well as the history of science. The program's areas of particular strength include the social and cultural history of technology, both American and European; technology and science policy; the history of the physical sciences since the Renaissance; gender issues in technology and science; the history of medicine; and the history of the environment. The course of study for the PhD includes the MA requirements, written and oral qualifying examinations, and a dissertation. While most graduates of the program teach at colleges or universities, others work in museums or archives or deal with science policy questions.

General PhD Program
In addition to the specialized SHP and STEM programs, the Department of History also offers a general PhD in history, allowing students to specialize in any geographical, temporal, or topical area of history adequately covered by department faculty. In the past, this general program has been largely restricted to students pursuing topics in U.S. history (including American women's history, African-American history, U.S. cultural history, and the history of social movements), but the gradual expansion of the department now allows us to support PhD work in certain comparative or non-U.S. fields. All prospective graduate applicants are strongly encouraged to examine the research specialties of department faculty before applying to the program.

Department Faculty
Kenneth F. Ledford, PhD, JD
(Johns Hopkins University; University of North Carolina)
Associate Professor and Chair
Modern German history; Modern European history; European legal history; history of the professions

John Broich, PhD
(Stanford University)
Associate Professor
British history; British Empire; environmental history; history of public health

Daniel Cohen, PhD
(Brandeis University)
Associate Professor
Colonial America; U.S. cultural history

Ananya Dasgupta, PhD
(University of Pennsylvania)
Assistant Professor
History of Modern South Asia; secularity in South Asia; gender and community in South Asia

John H. Flores, PhD
(University of Illinois at Chicago)
Associate Professor
Mexican American history; immigration; labor

Jay Howard Geller, PhD
(Yale University)
Samuel Rosenthal Professor of Judaic Studies; Associate Professor
Jewish history, modern European history, modern German history
Adjunct Faculty

Virginia Dawson, PhD  
(Case Western Reserve University)  
Adjunct Associate Professor  
History of science and technology

James M. Edmonson, PhD  
(University of Delaware)  
Adjunct Associate Professor; Director, Dittrick Medical History Center  
Medical history

Lecturers

Bernard Jim, PhD  
(Case Western Reserve University)  
Full-time Lecturer and SAGES Fellow  
19th- and 20th-century US history; American history of science and technology; gender; methodology

Elizabeth Todd, PhD  
(The Ohio State University)  
Part-time Lecturer  
Medieval history; Reformation Europe

Courses

HSTY 102. Introduction to Byzantine History, 500-1500. 3 Units.  
Development of the Byzantine empire from the emperor Constantine’s conversion to Christianity and founding of the eastern capital at Constantinople to the fall of Constantinople to Turkish forces in 1453. Offered as CLSC 102 and HSTY 102. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 103. Introduction to Medieval History, 500-1500. 3 Units.  
Medieval history and civilization from the fall of the Roman Empire to the age of the Renaissance. Interactions between medieval Europe and other Mediterranean and Eurasian cultures. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 104. Introduction to Early Modern European History, 1500-1800. 3 Units.  
Europe has not always existed. To find out who created it and when, this course will ask two fundamental questions: First, how did the geographic, linguistic, religious and ethnic characteristics of European identity develop over the course of the sixteenth, seventeenth and eighteenth centuries? Second, how did Europeans in this period influence other parts of the world? Through close readings of memoirs, treatises and chronicles, and discussions of secondary literature, we will explore the political, social, and religious history of Europe from roughly 1500 to 1800. Topics include: exploration and conquest; Protestant and Catholic reformations; witchcraft and popular culture; science and medicine; Enlightenment and Revolution. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 105. Introduction to Modern European History, 1750-present. 3 Units.  
The history of Europe from the late eighteenth century to the present. Themes include political upheavals and movements, as well as industrial, social, intellectual, and cultural changes. This course provides a solid foundation for those wishing to take more specialized courses in European history.
HSTY 107. Introduction to the Ancient Near East. 3 Units.
This is an introduction to the history and culture of the Ancient Near East, a land that, spanning from modern Iraq to Egypt, was home to the earliest known societies in written history. In this course we will learn about the relatively recent discoveries of these ancient civilizations, the first deciphering of their scripts, about the political, social, and cultural history of the peoples who gave rise to the Babylonian, Assyrian, and Egyptian empires (besides other Levantine and Anatolian powers and smaller nations such as Israel). Various aspects of the literary/scientific production of these societies will also be discussed, while reflecting upon their cultural legacy. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 108. Introduction to Early American History. 3 Units.
This course offers an introduction to American history through a thematic survey of colonial British North America and the early United States, from the first permanent English settlements of the early seventeenth century to the onset of the American Civil War. It focuses on (1) the emergence and development of contrasting social systems in the various colonies; (2) the causes and consequences of the American Revolution; and (3) the political, religious, and economic transformations of the period 1790 through 1860. Readings include a mix of primary sources (historical documents) and secondary sources (books and articles written by modern scholars). Students will examine a variety of historical methods and approaches but will particularly explore past social experiences and values through the personal (or autobiographical) writings of individual Americans of varying backgrounds. Particular attention will be paid to the experiences of women and African Americans. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 109. Modern American History Since 1877. 3 Units.
This course provides an introductory survey of American history from the end of Reconstruction through the early 21st century, focusing on politics, foreign relations, the economy, and culture and social life. It is designed not to replicate high school American history courses, but introduce undergraduates to major themes in how academic historians approach the past, as well as instructing students on how to read, discuss, and write about primary sources. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 110. Introduction to US History for International Students. 3 Units.
This course offers an introduction to U.S. history for international and other students who have not studied U.S. history in secondary school. The course will emphasize topics relevant to understanding how change over the past 250 years has shaped the diversity of the people, the development of the economy, and the government and politics, and the international position of the U.S. as they exist today. Students will read a mix of classic short historical documents, quantitative analyses, and interpretations by historians and social scientists. With respect to the peopling of the U.S. the course will consider the native populations of North America and the movements of people from Europe, Africa, Central America, and Asia, as well as the history of movement and interactions of people within the U.S.: the course will pay particular attention to slavery, segregation, and to changes in American households and families. With respect to economic affairs, the course will consider the history of economic growth, the development of business firms and other key economic institutions, and the question of distribution – of changes in wealth and poverty. With respect to government and politics, the course will consider the implications of the U.S. Constitution (including its emphasis on the separation of powers, federalism, "republican" values, private property, and the Bill of Rights) for the powers of the federal and state governments; the course will also consider the development and current roles of political parties in the U.S. With respect to international relations, the course will focus on the long-term expansion in U.S. engagement with the rest of the world, and on current challenges to the U.S. position. These topics attract deep and continuous debate; the aim of the course is to introduce students to the best current knowledge, and the most influential debates, about them.

HSTY 112. Introduction to American History. 3 Units.
History of the United States from the first settlements to the present. Emphasis on themes such as political and social revolution, slavery and race relations, industrialism, and national cultures.

HSTY 113. Introduction to Modern World History. 3 Units.
The history of the nineteenth and twentieth centuries in global context. Emphasis on the forces that have created or shaped the modern world: industrialization and technological change; political ideas and movements such as nationalism; European imperialism and decolonization; and the interplay of cultural values. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 117. Exploring American History Through Biography. 3 Units.
This discussion and lecture class uses various forms of biography to explore issues of American Identity throughout the course of American history. The class will discuss how certain biographies have created archetypal American identities, and how issues such as race, class, gender, sexuality, religion, and historical context have shaped the writing, reading and purpose of biography. The last third of the class will consider the process of "national memory" the way the United States has decide to remember its past. Here the "biography" is collective, and created by myriad strands of mass culture woven together to create a national mythology. We will explore the works of those striving to pull apart these different strands, and explore what these memories tell us about established national identity. Students will explore biographical process through their assignments, and consider such questions as: How do American biographies influence our understanding of what it means to be American? How does biographical medium affect the message? Can we accept biography as history? This course investigates biography as a constructed genre that comes in a variety of forms, including autobiography, biographical novels, oral histories, and film. Offered as AMST 117 and HSTY 117. Counts for CAS Global & Cultural Diversity Requirement.
Clothing is one of the most visible and accessible means through which we express our identities. Hence, it is hardly surprising that political and social tensions are embedded and embodied in dress. As an expressive medium, clothing and appearance became crucial in the construction of political identities and in serving as a means of control, oppression, as well as protest and resistance. This seminar will examine the links between clothing, sartorial practices and political significance. Special attention will be given to the role of clothes in negotiating and constructing gender, race, class, sexual, and national identities. Readings will address the question of sartorial politics from a historical perspective and will focus on American history and culture from the 18th century to the present. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 132. Introduction to Modern East Asia. 3 Units.
HSTY 132 is an introduction to the histories of modern China, Japan, Korea, and Vietnam from the “dawn of the global world” in the 17th century to present. Taken together these regions make up the geographic and cultural unit commonly referred to as “East Asia.” Over the course of the term, we will investigate the usefulness of this concept of “East Asia” by examining its origins as well as the sometimes convergent, sometimes divergent relations between this region and the rest of the world. We will also challenge the stereotype of a monolithic and static East Asia and see to develop a critical understanding of the internal and external forces integrating and dividing this region. We will examine how international diplomatic, commercial, military, religious, and cultural relationships shaped the individual countries as well as their relationships with each other and the world. The course sweeps over large regions of time and space. It aims to put the contemporary discussion of globalization into historical perspective by examining the long-lasting interactions of East Asian countries with each other and the rest of the world. These connections were economic, political, cultural, and psychological. Topics include: global silver and trade flows, warfare and military technology, imperial domination and revolutionary resistance, and the role of historical memory, as in Nanking or Hiroshima. Sources include historical documents, pictures, films, and memoirs. As we move through the course material our goal is not to gain total knowledge of modern East Asia, nor of China, Japan, Korea nor Vietnam. Rather, by the end of the term you should be able to identify some of the main organizing themes in modern East Asian history and develop a greater understanding of the construction and nature of historical knowledge itself. Offered as HSTY 132 and ASIA 132. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 133. Introduction to Chinese History and Civilization. 3 Units.
This course explains the continuities and discontinuities in the history of China by stressing the development and distinctive adaptations of cultural, religious, and political patterns from the origins of the Chinese civilization to the present. By focusing on major cultural, socioeconomic, and political issues such as Confucianism, Buddhism, trade relations, imperialism, and intellectual discourse in the overall Asian context (with particular reference to Korea and Japan), we discuss the historical development of China and its situation on entering the 21st century. Taking into account the key historical events in the last century, we examine the emergence of China as a modern nation-state and the fundamental transformation of Chinese society in the postwar period. Offered as ASIA 133 and HSTY 133.

HSTY 135. Introduction to Modern African History. 3 Units.
A general introduction to major themes in modern African history, with an emphasis on the nineteenth and twentieth centuries. Topics include oral tradition and narrative, economic structure and dynamics, religious movements, colonialism, nationalism, and the dilemmas of independent African states. Offered as ETHS 253B and HSTY 135. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 136. Introduction to Latin American History. 3 Units.
This course provides an introduction to the historical and cultural development of Latin America, in an attempt to identify the forces, both internal and external, which shape the social, economic and political realities in present day Latin America. Beginning with its pre-Columbian civilizations, the course moves through the conquest and colonial period of the Americas, the wars of independence and the emergence of nation-states in the nineteenth century, and the issues confronting the region throughout the turbulent twentieth century, such as migration and urbanization, popular protest and revolution, environmental degradation, great power intervention, the drug trade and corruption, and the integration of the region into the global economy. Offered as ETHS 253B and HSTY 136. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 137. Introduction to Modern South Asia. 3 Units.
This course will introduce students to the history of the region that today includes India, Pakistan and Bangladesh. The course will deal with the following themes: global trade between the Indian subcontinent and the West in the 17th century; the rise of the East India Company’s dominance over the Indian subcontinent in the 18th century; the transformation of India into a colonial economy; social and religious reform movements of the 19th century; changing modalities of colonial rule after the transfer of governing power from the East India Company to the British Crown-in-Parliament; the emergence and trajectories of elite and popular anti-colonial nationalisms; the struggles of women, low status groups, and other minorities in the region; decolonization; and the partition of the subcontinent. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 138. Radical History in America. 3 Units.
This course examines the radical tradition in America from the time of the American Revolution until the present. Topics will include abolitionism, suffrage, anarchism, socialism, communism, black power, feminism, the New Left, radical environmentalism, and queer liberation. Recommended Preparation: High school American history. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 151. Technology in European Civilization. 3 Units.
The history of technology in ancient Mediterranean, medieval, and modern European society until the First World War. The course introduces students to the relationship between technology and its social, political, and cultural settings, and to the values invested in technology at significant historical moments. There will be visits to local industrial sites, architectural and engineering monuments, and the Cleveland Museum of Art.

HSTY 152. Technology in America. 3 Units.
Origins and significance of technological developments in American history, from the first settlements to the present. Emphasis on the social, cultural, political, and economic significance of technology in American history.
HSTY 157. Women's Histories in South Asia. 3 Units.
This course traces the history of women in South Asia from pre-colonial times to the present. Themes explored in the course will include (but not be limited to): the historical transformations of institutions shaping women's lives such as state, family, religious and legal traditions; the impact of colonialism, nationalism, and decolonization on women, as well as the history of women's movements in various parts of South Asia. As we acquaint ourselves with the vibrant historiography on women in South Asia, we will also examine the theoretical and methodological challenges involved in writing histories using the analytical lens of gender. While a significant portion of the readings will focus on South Asia, we will occasionally bring in insights from histories of women in other parts of the world to help develop comparative perspectives and evaluate the South Asian cases and examples within the broader field of women's history. Offered as HSTY 157 and WGST 257. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 163. Modern Britain and Its Empire. 3 Units.
This lecture and discussion course covers the history of Britain at the height of its political and industrial power and the history of the expanding and contracting British Empire. Britain was a nation of great technological, economic, and military power, but it also experienced extraordinary stresses. Industrialization meant material prosperity for some, but hardship and dehumanization for others. Many questioned how overwhelming poverty and ignorance could be allowed to stand beside such vast affluence. And subjects of the British in India, Ireland, and elsewhere struggled for independence from an empire that claimed to bring freedom, reason, and equality. The British learned to their cost, too, that decolonization often meant being caught in the crossfire of ethnic rivals. This course will explore the many paradoxes of the history of the British at their most dominant. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 193. The Ancient World. 3 Units.
Ancient Western history from the origins of civilization in Mesopotamia to the dissolution of the Roman Empire in the West. Offered as CLSC 193 and HSTY 193. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 201. Science in Western Thought I. 3 Units.
The development of Western thinking about the natural world and our relation to it, as part of culture, from pre-classical civilizations to the age of Newton.

HSTY 202. Science in Western Thought II. 3 Units.
The development of Western thinking about the natural world and our relation to it, as part of culture, from Newton to the modern age. HSTY 201 is not a prerequisite.

HSTY 203. Revolutions in Science. 3 Units.
Historical and philosophical interpretation of some epochal events in development of science. Copernican revolution, Newtonian mechanics, Einstein's relativity physics, quantum mechanics, and evolutionary theory; patterns of scientific growth; structure of scientific "revolutions;" science and "pseudo-science." First half of a year-long sequence. Offered as HSTY 203 and PHIL 203.

HSTY 204. Introduction to the Nonprofit Sector. 3 Units.
The United States has by far the largest and most important "nonprofit sector" in the world, a sector consisting of voluntary non-governmental organizations that provide health care, education and social services as well as arts, religious, and advocacy activities. Using mostly primary sources, this course considers the significance of the nonprofit sector in the U.S., its advantages and disadvantages, its uses for different groups of Americans, and current trends. Students have the option of writing either a standard term paper, or a study of strategic challenges facing a contemporary nonprofit organization. Offered as HSTY 204 and HSTY 404. Counts as SAGES Departmental Seminar.

HSTY 206. Ancient and Medieval Spain: Prehistory to 1492. 3 Units.
This course focuses on the history of the Iberian peninsula from before the Roman conquest from the Iberians, Greek, and Carthaginian settlements, through Roman, Visigothic, and Muslim rule to the conquest of Ferdinand and Isabella of the last non-Christian territory on the peninsula in 1492. The issues of conquest, frontier, cultural diversity, and change, tolerance, and intolerance will be examined. Offered as CLSC 206 and HSTY 206. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 207. Philosophy of Science. 3 Units.
Conceptual, methodological, and epistemological issues about science: concept formation, explanation, prediction, confirmation, theory construction and status of unobservables; metaphysical presuppositions and implications of science; semantics of scientific language; illustrations from special sciences. Second half of a year-long sequence. Offered as HSTY 207 and PHIL 204.

HSTY 208. Social History of Crime. 3 Units.
This course explores the relationship between law and history in American society. It uses social history methodology to suggest new ways of understanding how the law works as a system of power to advance certain interests at the expense of less powerful groups. Emphasis is on issues of pressing concern to America's poor and working class, including the death penalty, abortion, rape, the war on drugs, and the prison industry.

HSTY 215. Europe in the 20th Century. 3 Units.
The twentieth century has seen stupendous transformations in the internal structures of European politics, economics, society, and culture and in Europe’s place in the world. This course traces Europe's transition from a continent of sovereign nation-states or empires ruled by monarchs with starkly hierarchical social structures, through wars, revolution, dictatorships, destruction, division, and destitution, to a conflicted present. The contradictory combination of peace, freedom, and pluralism combined with cultural critique of the very consumer society that has reduced conflict challenges students' linear notions of historical development. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 216. Vikings and Medieval Scandinavia. 3 Units.
A survey of the history of the Vikings and medieval Scandinavia, covering approximately the eighth to the fifteenth centuries AD. Topics explored include: causes of the "outbreak" and cessation of Viking expeditions, the role of the Vikings as raiders and/or traders in Western Europe, the role of the Vikings in the emerging states of Russia, Iceland and medieval Scandinavian law, the historicity of the saga literature, and Viking descendents—Normans and "Rus." Counts for CAS Global & Cultural Diversity Requirement.
HSTY 218. Jews in Early Modern Europe. 3 Units.
This course surveys the history of Jews in Europe and the wider world from the Spanish expulsion through the French Revolution. Tracking peregrinations out of the Iberian Peninsula to the British Isles, France, Holland, Italy, Germany, Poland-Lithuania, the Ottoman Empire, and the American colonies, it examines the diverse ways Jews organized their communities, interacted with their non-Jewish neighbors, and negotiated their social, economic, and legal status within different states and empires. What role did Jews play and what symbolic place did they occupy during a period of European expansion, technological innovation, artistic experimentation, and religious and political turmoil? What internal and external dynamics affected Jewish experiences in the sixteenth, seventeenth, and eighteenth centuries? Through a selection of inquisitorial transcripts, government records, memoirs, and historical literature, we will explore topics such as persecution, conversion, messianism, toleration, emancipation, and assimilation. Offered as HSTY 218, JDST 218, and ETHS 218. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 219. Berlin in the Tumultuous 20th Century. 3 Units.
The tumultuous but short twentieth century began and ended with a united Germany, with Berlin as its capital. But in between, Berlin, and Berliners, experienced the extremes of the economic, technological, and cultural progress that the century brought, and the devastation, violence, division, and uncertainty that it also brought. This course, taught with Berlin as its laboratory, introduces students to the German tumult of the twentieth century. We will read about historical events and developments, and then visit the places where those events and developments occurred. We will address persistent questions, such as why and how did Hitler come to power; what was life like behind the Berlin Wall; why is there a Forever 21 across from the Kaiser-Wilhelm-Memorial Church; how does one come to grips with a history like Germany’s in the twentieth century; and what has life been like for ordinary Berliner/innen. Students are welcome to take this course before they have any background or acquaintance with the German language, although the instructor expects students to be able to navigate independently in Berlin after he provides them with an introduction. German proficiency will enrich the student’s experience in Berlin, and the instructor hopes that some of the students who enroll will already be pursuing the study of the German language. The instructor further hopes that students who have never before studied German language will be inspired to begin to learn German after they return to Case Western Reserve. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 220. The Early Modern Mediterranean. 3 Units.
For centuries before Columbus crossed the Atlantic Ocean, travelers and traders, pirates and pilgrims, mercenaries and missionaries explored the contours of the Mediterranean Sea—and engaged in commerce, as well as religious, economic and military competition. If religion and ethnicity divided Muslims, Christians and Jews from Algiers to Athens, did shared geography, foodstuffs, and cultural values bind them together? This course examines the unity and diversity of this maritime region by considering the peoples, beliefs, commodities and diseases that circulated through it during the sixteenth, seventeenth, and eighteenth centuries. Does the early modern Mediterranean showcase a clash of civilizations or provide an enduring model for coexistence? Topics include merchant culture, diplomacy, honor and shame, slavery and colonization. Offered as ETHS 220 and HSTY 220. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 222. Becoming Ken Burns: An introduction to Public History. 3 Units.
This course focuses on the practice of public (applied) history in the United States. Its purpose is to familiarize students with the background (historical and contemporary) of the manners in which history is taught and used outside of the school or college classroom as well to familiarize them with potential careers in public history, including museum work; editing; documentary film production; and the growing business of "history for hire." This overview will be complemented by an examination of a number of major issues in public history including the debate as to whether it can be as authoritative and insightful as academic scholarship, and the potential influences of the marketplace and politics on the topical focus and accuracy of public history "products." The course combines lecture and seminar-style classroom sessions with a variety of assigned readings, site visits, and an examination of public history products ranging from documentaries to monuments and recreated historical "landscapes" in order to provide students with a theoretical and "actual" introduction to the field. All assignments and examinations will be structured as essays based upon readings, lectures, discussion, site visits, and independent research conducted by the student.

HSTY 225. Evolution. 3 Units.
Multidisciplinary study of the course and processes of organic evolution provides a broad understanding of the evolution of structural and functional diversity, the relationships among organisms and their environments, and the phylogenetic relationships among major groups of organisms. Topics include the genetic basis of micro- and macro-evolutionary change, the concept of adaptation, natural selection, population dynamics, theories of species formation, principles of phylogenetic inference, biogeography, evolutionary rates, evolutionary convergence, homology, Darwinian medicine, and conceptual and philosophic issues in evolutionary theory. Offered as ANTH 225, BIOL 225, EEPS 225, HSTY 225, and PHIL 225.

HSTY 229. Asian Christianity: Historical Perspectives. 3 Units.
The history of Christianity in Asia is as old as the history of Christianity itself. But while much has been told about Christianity as it grew from an obscure Jewish sect to mighty Western Christendom, not enough attention has been given to the Christianity which spread eastwards to Asia in the first millennium of the Christian era. This course seeks to correct the imbalance by introducing students to a historical exploration of the eastward movement of Christianity from Jerusalem to different parts of Asia. Topics include the Assyrian Church of the East in Persia, India and China, European Catholic and Protestant colonial missions in the age of European imperialism, and the Jesuit missions to Japan and China. By the end of the semester, students should have a good grasp of the historical encounter of Christianity with the political, social, cultural and religious realities of Asia. Its dialogue and confrontation with these realities and the forces that led to its growth and decline. Offered as HSTY 229 and RLGN 229. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 231. Athens to Alexandria: The World of Ancient Greece. 3 Units.
This course constitutes the first half of a year-long sequence on classical civilization. It examines the enduring significance of the Greeks studied through their history, literature, art, and philosophy. Lectures and discussion. (For the second course in the sequence, see CLSC 232 and HSTY 232.) Offered as CLSC 231 and HSTY 231. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 232. Gods and Gladiators: The World of Ancient Rome. 3 Units.
The enduring significance of the Romans studied through their history, literature, art, and philosophy. Lectures and discussion. Offered as CLSC 232 and HSTY 232. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 234. France and Islam. 3 Units.
This seminar examines French encounters with the Muslim world from the Middle Ages to the present. Over the last millennium, France has viewed Saracens, Moriscos, Turks, Berbers, and Arabs with admiration and fear, disdain and incomprehension. Between the eleventh and thirteenth centuries, French soldiers battled in the Holy Land; for several hundred years after that, France and the Ottoman Empire exchanged diplomats, traders and slaves. The colonial occupation of Algeria that began in 1830 ended violently in 1962. By then, the empire that struck back had also come home through large waves of immigration. Today, the social and economic status, religious affiliation, political significance and cultural impact of French citizens of North African descent are the subject of burning national debate. Taking a long view on Franco-Muslim relations, the course will explore such topics as the Crusades, Mediterranean piracy and captivity, Napoleon’s Egyptian campaign, the Algerian War of Independence, the “veil affair” riots in the suburbs of Paris and World Cup soccer. Offered as ETHS 234 and HSTY 234. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 235. Pirates in the Early Modern World. 3 Units.
From the Caribbean to Somalia, pirates have captivated the American imagination. Beyond examining images of heroic outlaws and bloodthirsty criminals in popular culture and current affairs, this course investigates maritime predators of the early modern period (16th-18th centuries). With a focus on the Mediterranean and the Atlantic—and forays into the Indian Ocean, the Red Sea and elsewhere—it considers the motivations and strategies of sea robbers and the responses of states. What, it asks, can Barbary corsairs, Dutch freebooters, Spanish “sea dogs,” and Catholic privateers, teach us about social rebellion, religious conflict, economic development, political authority, legal norms, naval power and imperial expansion? Counts for CAS Global & Cultural Diversity Requirement.

HSTY 236. World War I: Crucible of the 20th Century. 3 Units.
World War I changed everything about Europe and ushered in a changed century of tumult, war, and division. The European experience of the regeneration of the economy and daily life, the impact of new technology on warfare, and the very personal suffering of separation and loss changed how those on that continent viewed their countries and their world. The war affected everything from gender relations to class relations to religious and ethnic relations and laid the foundation for even more disruption ahead. Its legacy reaches our day and colors our own views of what is normal and what is possible. This course will explore those multiple and manifold legacies of this founding experience of modernity. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 237. WWII: How Britain Saved the World and Lost an Empire. 3 Units.
This lecture and discussion course gives students the opportunity to learn about the Second World War from the perspective of the British and their soldiery from around the globe. Many might come to the course with images of the American “Bands of Brothers” fighting across France in 1944. But that was the end of the war. In the beginning, it fell to the British leadership (famously embodied by Winston Churchill), British people, and to an extraordinary extent the Indian Army to withstand a pummeling at the hands of the Axis powers long enough for America to join the conflict. The course will examine those in Britain who might have preferred a move towards Fascism in the late 1930s. It will investigate why imperial subjects who lacked democracy in their own lands fought for the British in the name of democracy against totalitarianism. And it will scrutinize those in the Empire who instead sided with the Axis. In sum, students will have an opportunity to learn what led to those many moments of choice and chance that led to Allied victory and the defeat of Fascism. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 241. Inventing Public Health. 3 Units.
The core principle of this course is that public health is a concept that was formed in different ways at different times in different places. It had no existence as we know it before the nineteenth century, but course participants will learn how it grew out of an ancient tradition of the political elite’s concern that its subjects were a threat to them and the stability of the realm. Course participants will discover how, in the nineteenth century, it became a professional practice as we know it and realized advances in human health, longevity, and security perhaps greater than any made since. At the same time, the course will also cover how many of the assumptions of those that inaugurated public health were completely alien to present-day practitioners—even though in many ways it is a practice that helped inaugurate the modern world so familiar to us. Course participants will learn about the close relationship between public health agencies and agendas and various kinds of social authority: political power, moral influence, colonial power, and others. Ultimately, the aim of the course is to show participants that even though public health seems a supremely common sense practice, it had a highly contested birth and early life that was anything but natural or pre-ordained. That complicated birth continues to shape public health to this day. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 243. The Age of Prozac: Social and Cultural Aspects of Depression. 3 Units.
Although often experienced as an intensely individual, private, and painfully isolated affliction, depression has profound social and cultural dimensions. This course will neglect neither biological (neurochemical or genetic) perspectives, nor personal or psychological aspects, but will emphasize perspectives derived from history, anthropology, and sociology. While there may be tangential attention to bi-polar disorder (“manic depression”), the emphasis will be on unipolar depression. The course will conclude with an in-depth exploration of the rise of pharmaceutical treatments.
HSTY 249. The Global Middle Ages: From Paris to Baghdad. 3 Units.
This reading-intensive course will explore the ways in which medieval thought was manifested in Christian and Islamic art, and discuss parallels, divergences, and convergences between the two visual cultures. Topics will include, but will not be limited to, medieval attitudes towards the body as manifested in illuminated manuscripts; art as a tool for religion and a vehicle for devotion; illustrations in herbals and medical books; advances in architecture; literary themes translated into visual art; art created by and for women, and the image as an instrument for political thought and propaganda. While Christian and Islamic visual cultures are traditionally studied separately, this course will examine medieval culture as a whole, thereby providing the students with a distinctive educational experience. Offered as ARTH 249 and HSTY 249. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 250. Issues and Methods in History. 3 Units.
A methodological introduction to historical research. Students use a variety of approaches to interpret and study historical problems. Specific topics and instructors normally vary from year to year.

HSTY 252A. Introduction to African-American Studies. 3 Units.
This course is designed to introduce students to the study of Black History, cultures, economics, and politics. Students will learn about the development of the field by exploring theoretical questions, methodological approaches, and major themes that have shaped the study of black people, primarily in the U.S. context. This is a seminar-style, discussion-based course that emphasizes critical analysis and expository writing. Offered as ETHS 252A and HSTY 252A. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 254. The Holocaust. 3 Units.
This class seeks to answer fundamental questions about the Holocaust: the German-led organized mass murder of nearly six million Jews and millions of other ethnic and religious minorities. It will investigate the origins and development of racism in modern European society, the manifestations of that racism, and responses to persecution. An additional focus of the course will be comparisons between different groups, different countries, and different phases during the Nazi era. Offered as HSTY 254, RLGN 254, ETHS 254, and JDST 254. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 255. Economic History of the United States. 3 Units.
The growth of the American economy from the colonial period to the present. Competing explanations of economic growth; significant attention to the political and legal environment in which the U.S. economy developed; "lessons" of past experience for contemporary policy; some attention to inequality and the changing distribution of wealth and income. Offered as ECON 255 and HSTY 255.

HSTY 256. American Political History. 3 Units.
From the origins of American politics in the colonial period to the present. The Revolution and Constitutional debate; presidential politics and leadership; voters and voting patterns; Congress and the courts. Emphasis both on the ideas that animated American politics and on the relation of politics to society.

HSTY 257. Immigrants in America. 3 Units.
Immigration to America has constantly reshaped the way the nation views itself. This course examines the overall history of immigration to the United States, but places that movement within a global context. It also pays particular attention to the roles that policy and technology have played in controlling or defining immigration to America. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 258. History of Southern Africa. 3 Units.
A survey of southern Africa from about 1600. Topics include the social structure of pre-colonial African societies, the beginnings of European settlement, the rise of Shaka, the discovery of minerals and the development of industry, Zimbabwe's guerrilla war and independence, and the rise and apparent demise of apartheid. Offered as ETHS 258 and HSTY 258. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 259. Introduction to Latina/o Studies. 3 Units.
Interdisciplinary introduction to the basis for a Latina/o ethnicity through an exploration of commonalities and differences in the peoples of Latin American and Caribbean origin within the continental United States. Topics include methodological and theoretical formulations central to the field (e.g., racial, gender, and sexual formations, modes and relations of production and class, nation and transnational), history and contemporary issues of identity, family, community, immigration, and the potential for a pan-ethnic identity. Discussions will focus on major demographic, social, economic and political trends: historical roots of Latinas/os in the U.S.; the evolution of Latina/o ethnicity and identity; immigration and the formation of Latina/o communities; schooling and language usage; tendencies and determinants of socioeconomic and labor force status; discrimination, segregation and bias in contemporary America; racial and gender relations; and political behavior among Latinas/os. Offered as: ETHS 252B and HSTY 259. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 260. U.S. Slavery and Emancipation. 3 Units.
Begins with the African encounter with Europeans during the emergence of the modern slave trade. Students are introduced to the documents and secondary literature on the creation and maintenance of slavery, first in colonial America, and then in the United States. The course concludes with the destruction of slavery. Offered as ETHS 260 and HSTY 260. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 261. African-American History 1865-1945. 3 Units.
Explores the fashioning of a modern African-American culture between emancipation and the end of World War II. Emergence of a northern-based leadership, the challenge of segregation, emergence of bourgeois culture, the fashioning of racial consciousness and black nationalism, the shift from a primarily southern and rural population to one increasingly northern and urban, the creation and contours of a modern African-American culture, the construction of racial/gender and racial/class consciousness. Offered as ETHS 261 and HSTY 261. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 262. African-American History Since 1945. 3 Units.
Completes the three-term sequence of the African-American history survey (although the first two courses are not prerequisites for this course). Explores some of the key events and developments shaping African-American social, political, and cultural history since 1945. Offered as HSTY 262 and ETHS 262. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 266. Introduction to Asian American History. 3 Units.
This course provides an introduction to the history of Asians in the United States from the mid-19th century to the beginning of the 21st century. Through lectures, readings, films, and discussions, we will examine the continuities and changes in the experience of Asian Americans through three chronological periods: the first wave of immigration (mid-19th century to 1934), the period of exclusion and international conflict (mid-20th century), and the second wave of Immigration (post-1965). Key events covered include the passage of the Chinese Exclusion Act, the Philippine War, Japanese internment and World War II, the Asian American Movement, the murder of Vincent Chin, and labor organizing. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 270. Introduction to Gender Studies. 3 Units.
This course introduces women and men students to the methods and concepts of gender studies, women's studies, and feminist theory. An interdisciplinary course, it covers approaches used in literary criticism, history, philosophy, political science, sociology, anthropology, psychology, film studies, cultural studies, art history, and religion. It is the required introductory course for students taking the women's and gender studies major. Offered as ENGL 270, HSTY 270, PHIL 270, RLGN 270, SOCI 201, and WGST 201. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

HSTY 272. Sports in America: From Play to Profit. 3 Units.
This course reviews the history of sports in America from the colonial period to the present. It gives particular attention to the evolution of sports as a major business and to the roles of gender, ethnicity, and race in the history of America sport, as well as to the emergence of sport as a major defining characteristic of America life and society. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 278. Nineteenth-Century Europe. 3 Units.
This course examines the history of Europe during the so-called long nineteenth century, lasting from the French Revolution, which signaled the end of the Old Order, through World War I, which led to the end of the European primacy in the world. Major themes include decline of aristocratic hegemony, the emergence of new ideologies (especially nationalism, liberalism, and socialism), the rise of the bourgeoisie, culture in Europe's golden age, and increasing national rivalry and competition. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 280. History of Modern Mexico. 3 Units.
This course explores the major issues that have influenced the formation of modern Mexico. This class is organized around three major themes. First, we will examine Mexican identity formation and its political implications. Second, we will assess Mexican life in relation to the development of the Mexican economy. Finally, we will survey how elite and popular forms of violence have affected Mexican society. Throughout the course, we will discuss the significance of the colonial heritage, regional distinctions, racial and gender stratification, and the creation and reconfiguration of various types of borders. Offered as HSTY 280 and ETHS 280. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 288. Imperial China: The Great Qing. 3 Units.
This course is an introduction to the history of Imperial China, from the fall of the Ming Dynasty in 1644 to the creation of the Chinese republic in 1912. We will explore the major historical transformations (political, economic, social, and cultural) of the last imperial dynasty, the Qing (1644-1911), and develop an understanding of the major social, political, economic, and intellectual cultural forces shaping the formation of modern China. Contrary to commonly-held ideas in both West and in China that traditional Chinese society was timeless or stagnant, historians now see dramatic and significant changes during this period— to the economy; to gender relations; to religion; and to many other aspects of life. This course surveys the social, political, economic, and cultural history of this era, with emphasis on recent research. The main goals of the course will be to acquaint students with the key changes and to show the interplay between economic, social, and cultural changes on the one hand and political developments on the other. By the end of the semester you should have a good sense of how Chinese society was transformed over the course of the 17th through early 20th centuries. The topics we will discuss include urbanization and commerce; gender, family and kinship; education and the examination system; opium and free trade; and ethnicity and nationalism. Offered as ASIA 288 and HSTY 288. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 289. Reform, Revolution, Republics: China 1895 to Present. 3 Units.
Completes a two-term sequence of the Chinese history survey, although HSTY 288 is not a prerequisite for this course. Beginning with the First Sino-Japanese War (1895), we review the historical development of intellectual discourse, public reaction, and political protest in later Imperial China through the creation of the People's Republic in 1949 forward to contemporary times. In contrast to the conventional description of China from a Western point of view, this course tries to explain the emergence of modern China in the context of its intellectual, political, and socio-economic transformation as experienced by Chinese in the late 19th and into the 20th century. By discussing the influence of the West, domestic rebellions, and political radicalism, we examine how the Chinese state and society interacted in search for modernization and reforms, how these reforms were continued during the Republican period, and to what extent historical patterns can be identified in China's present-day development. Offered as ASIA 289 and HSTY 289. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 292. Energy and Environment in American History 1750-2010. 3 Units.
This course uses the prism of energy to examine the history of the United States from the colonial period to the present. We will consider how energy has affected, and is affected by, American society, culture, science and technology, politics, diplomacy, and the environment. Four broad, thematic questions will recur throughout the semester. First, how has increasing energy use transformed American social life, the economy, and politics? Second, what are the relationships between energy consumption and environmental change? Third, what are the relationships between scientific discoveries, technological innovation and social change? And finally, how did the United States grow to be the largest consumer of energy in the history of the world? Addressing these questions will reveal the fundamental ways in which energy has shaped American history.

HSTY 293. History of Drugs. 3 Units.
This course will survey the rise and political, social, and cultural effects of drugs in modern societies with an emphasis on the late 19th and 20th century United States. First we will examine the global emergence and popularization of drugs as part of what David Courtwright has coined the "psychoactive revolution." Then, we will narrow this broad lens by shifting our gaze to narcotics in the expanding U.S. nation. Specifically, we will examine the shifting demographics, nature of, and debates regarding narcotic consumption, regulation, and policy--and how these disparate affect and shape the lives of diverse populations. Finally, we will explore the human toll of narcotics in post-World War II culture and cities. Counts as SAGES Departmental Seminar.

HSTY 299. Topics in History. 3 Units.
Subject matter will vary with instructor but will focus on some particular topic or historical approach. Course description available from departmental office.

HSTY 302. Ancient Greece: Archaic, Classical, and Hellenistic Periods. 3 Units.
The rise of Hellenic thought and institutions from the eighth to the third centuries B.C., the rise of the polis, the evolution of democracy at Athens, the crises of the Persian and Peloponnesian Wars, fifth-century historiography, the growth of individualism, and the revival of monarchy in the Hellenistic period. Offered as CLSC 302 and HSTY 302. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 303. History of the Early Church: First Through Fourth Centuries. 3 Units.
Explores the development of the diverse traditions of Christianity in the Roman Empire from the first through the fourth centuries C.E. A variety of New Testament and extra-Biblical sources are examined in translation. Emphasis is placed on the place of Christianity in the larger Roman society, and the variety of early Christian ideals of salvation, the Church, and Church leadership. Offered as HSTY 303 and RLGN 373. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 304. Ancient Rome: Republic and Empire. 3 Units.
Growth and development of the Roman state from the unification of Italy in the early third century B.C. to the establishment of the oriental despotism under Diocletian and Constantine. The growth of empire in the Punic Wars, the uncertain steps toward an eastern hegemony, the crisis in the Republic from the Gracchi to Caesar, the new regime of Augustus, the transformation of the leadership class in the early Empire, and the increasing dominance of the military over the civil structure. Offered as CLSC 304 and HSTY 304. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 306. History of Museums: Theory and Reality. 3 Units.
This course is an intensive summer internship (10 hours per week) at the Western Reserve Historical Society, complemented by extensive readings in museum/archival theory and public historical perception. It is designed both to introduce students to museum/archival work and to compare theoretical concepts with actual museum situations. Interns will be assigned a specific project within one of the Society's curatorial or administrative divisions, but will have the opportunity to work on ancillary tasks throughout the Historical Society's headquarters in University Circle. Offered as HSTY 306 and HSTY 406.

HSTY 307. Development of Chemistry and Chemical Engineering. 3 Units.
The development of chemical ideas; theories of matter, composition, structure, and reaction; the application of chemistry and chemical theory from antiquity to the 20th century, all considered in social context. Recommended preparation: One year of college chemistry. Offered as HSTY 307 and HSTY 407.

HSTY 308. Body, Health and Medicine in Chinese Religions: Historical and Contemporary Perspectives. 3 Units.
This course critically evaluates the history and development of traditional Chinese approaches to health and medicine in the context of Chinese religious, philosophical, and socio-cultural history. It examines the constructions of the body in Chinese religious and philosophical thought across different historical periods and evaluates their significance and implications for understanding Chinese approaches to health and medicine. It discusses the conceptions of "health" and "good health" in ancient China, the distinction between "healing" and "curing," the development of the complementary yin-yang and five phases (wuxing) theories, understandings of nature (xing) and body (ti), the concept of qi as life force, and various microcosm-macrocosm analogies that emerged from Chinese religious and philosophical traditions. It explores how these religious and philosophical frameworks, beginning with the Daoist classic, Basic Questions in the Inner Classic of the Yellow Emperor (Huangdi Neijing Suwen) have evolved to undergird the development of diet, acupuncture, moxibustion, meditation, and various alchemical practices within Chinese holistic conceptions of health and practices of Traditional Chinese Medicine. Offered as RLGN 307, RLGN 407, CHIN 307, HSTY 308, and ETHS 307. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 309. Reformation Europe, 1500-1650. 3 Units.
Origins and development of Protestantism, the Catholic Counter-Reformation, and the interaction between secular power and religious identity in Christian Europe. Offered as HSTY 309 and RLGN 374. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 310. The French Revolutionary Era. 3 Units.
Causes, progress, and results of the internal transformation of France from 1789 to 1815; impact of revolutionary ideas on other European and non-European societies.

HSTY 311. Seminar: Modern American Historiography. 3 Units.
This seminar examines the approaches that professional historians of the United States have taken to the writing of American history in the past fifty years, with emphasis on changes in historical concerns, master debates among historians, and contemporary interests. Topics covered include national politics and government, economic development, social history, the history of ethnicity, race, and gender, and foreign policy and international relations. Each student will read widely and will prepare a series of reports on selected books and authors. Offered as HSTY 311 and HSTY 411.

HSTY 315. Heresy and Dissidence in the Middle Ages. 3 Units.
Survey of heretical individuals and groups in Western Europe from 500 - 1500 A.D., focusing on popular rather than academic heresies. The development of intolerance in medieval society and the problems of doing history from hostile sources will also be explored. Offered as HSTY 315 and RLGN 315. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 318. History of Black Women in the U.S.. 3 Units.
Chronologically arranged around specific issues in black women's history organizations, participation in community and political movements, labor experiences, and expressive culture. The course will use a variety of materials, including autobiography, literature, music, and film. Offered as ETHS 318, HSTY 318, and WGST 318.

HSTY 319. The Crusades. 3 Units.
This course is a survey of the history of the idea of "crusade," the expeditions of Western Europeans to the East known as crusades, the Muslim and Eastern Christian cultures against which these movements were directed, as well as the culture of the Latin East and other consequences of these crusades. Offered as HSTY 319 and RLGN 319. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 320. Alexander the Great: Materials and Methods. 3 Units.
This course is the Classics Departmental Seminar in the SAGES sequence (normally taken in the Spring semester of a major's Junior year), though it can also be taken for regular credit in Classics or History by both undergraduate and graduate students. The seminar offers students a firm grounding in the discipline of Classics with an emphasis on the diverse materials (particularly primary source material), methods and approaches that can be brought to bear on the study of Greco-Roman antiquity. Students will read and discuss the ancient sources and contemporary scholarship on the enigmatic Alexander the Great drawn from various fields of classics, including history, archaeology, art history, philosophy, gender studies, epigraphy, numismatics, and the reception of Alexander. Based upon this, they will then write a research paper that employs conventions found in the field of Classics. Much of this training, however, will also be transferable to other fields and periods. Because the scope of the seminar moves (along with Alexander himself) beyond Europe and examines the historical foundations of the antagonism between East and West, this course qualifies as a Global and Cultural Diversity course. Offered as CLSC 320, CLSC 420, HSTY 320 and HSTY 420. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 321. The Archaeology of Iron Age Italy and Sicily, ca. 1000-300 BCE. 3 Units.
This course traces the early history and archaeology of the Italian peninsula and Sicily from ca. 1000 BCE to 300 BCE. During this period, the movement of people brought with a transfer of people, ideas, and culture (both social and material) that would transform the population and landscape of ancient Italy and Sicily. We will look first at Southern Italy and Sicily, where, from about 750 BCE, Greek and Phoenician colonists settled. We will examine the characteristics of Greek and Phoenician colonies and monuments, as well as the characteristics of the interactions between the new arrivals and the indigenous population, especially the Sikels. We will then examine how the Villanovan culture was supplanted by the Etruscans in west-central Italy. Through the close examination of the material culture we will address topics such as status, urbanization, religion and ritual, and the cultures of Italy and Sicily within the wider Mediterranean world. Finally, we will look at another movement of people and politics: the expansion of Roman hegemony throughout the peninsula. Numerous theories attempt to explain the effect Roman occupation had on the other populations. We will analyze critically these theories and look for ourselves on the numerous ways indigenous populations could respond to "foreign" occupants and how the occupants responded to the indigenes. We will "read" material culture almost like text, guided by concepts such as "style," "agency" and "habitus" among others. Through these lenses we will examine the archaeological material from multiple points of view (social, economic, religious, political). In turn, recent theoretical advances that seek to explain the processes of accommodation and emulation of, and resistance to, outside cultural influences will be looked at with a critical eye so that we can come away with fresh ideas about understanding what, and who, culture really is. Offered as CLSC 321 and HSTY 321. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 322. Christianity in China. 3 Units.
This course critically evaluates Christianity's long history in China, beginning with the "Luminous Religion" (Jingjiao) that was propagated by Assyrian Christian missionaries in Tang China (7th century CE), the missionary endeavors of Catholic and Protestant foreign missionaries and mission societies, the rise of indigenous Chinese Christianities that sought independence from foreign missionaries, the impact of communist rule and the Cultural Revolution, and current developments involving both the official government-approved churches (i.e., the Three Self Patriotic Movement and the Chinese Patriotic Catholic Association) on the one hand, and the house church movement (jiating jiaohui) on the other hand. Students will critically discuss and analyze the historical dimensions of Christianity's presence in China and engagement with various social, cultural, political, philosophical, and religious aspects of Chinese society, past and present, and consider the implications of emergent forms of contemporary indigenous Chinese Christian movements for the future of Chinese Christianity. Offered as RLGN 316, RLGN 416, HSTY 322, CHIN 316 and ETHS 326. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 324. Issues in Indian and Southeast Asian Art. 3 Units.
This course covers topics in the history of India and neighboring regions with emphasis on connections with works in the Cleveland Museum of Art. Offerings include The Buddha Image, Murals and Manuscripts, The Hindu Temple, Krishna in Art and Literature, and the History of Mughal Painting. Lectures, discussions, and reports. Offered as ARTH 342, ARTH 442, and HSTY 324. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 325. U.S. Politics, Culture, and Society: 1790-1860. 3 Units.
This is a survey of the history of the United States during the years between the Revolutionary era and the Civil War, exploring the transformation of American politics, religion, and culture, as well as the emergence of distinctive regional economies and social systems in the South, the Midwest, and the Northeast. It focuses especially on the emergence of the social institutions, patterns, and conflicts that still characterize the United States during the early twenty-first century. Particular attention is also paid to the experience of women and African Americans.

HSTY 326. The Holocaust and the Arts. 3 Units.
This course explores artistic output during the Holocaust, as well as responses to the Holocaust in various forms, including music, art, architecture, film, and literature. Offered as MUHI 326, JDST 326, HSTY 326 and RLGN 326 Counts for CAS Global & Cultural Diversity Requirement.

HSTY 327. Comparative Environmental History. 3 Units.
Environmental history is the study of how humans have influenced the environments around them and how the environment itself has influenced the course of human societies. This course provides students with the skill to identify and analyze these interactions. It introduces course participants to the main themes of environmental history literature and the driving questions guiding environmental history research by examining case studies drawn around the globe, including Pre-Columbian America, Medieval Japan, Colonial Africa, and Modern Germany. This course will help course participants recognize the important patterns and developments that have led to present day human-environmental relationships. Offered as HSTY 327 and HSTY 427. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 328. Comparative Perspectives on Museum and Archive History and Practice. 3 Units.
Comparative Perspectives on Archives and Museum History and Practice is a distance learning based course shared with students at Bilkent University in Ankara, Turkey. The course focuses on a comparison of the history and development of archives and museums in the United States and in late Ottoman and Republican Turkey. Topics considered include the “ownership” of culture; state vs. private control of heritage; marketing of museums; and the impact of evolving technologies on the presentation and preservation of culture. Students work together via a shared, live lecture format. In addition to the instructor, museum and archive professionals from both the US and Turkey provide lectures and lead discussions during the semester. The primary intellectual product of the course is a final paper/project which compares the history, operational structure, and mission of a museum/archive in the US with a similar institution in Turkey. The paper/project is created by collaborative effort between a student at CWRU and one at Bilkent. Provided grant funding is available, the course may involve exchange visits to Turkey and the US. Offered as HSTY 328 and HSTY 428. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 329. Museums and Globalization. 3 Units.
Museums are everywhere contested spaces today. Historically designed as symbols of power, centers for research, agents of public education and community formation in Western industrial societies, they have become sites of development and cultural controversy on a global scale. From Cleveland and Paris to Nairobi and Dubai museums figure in urban redevelopment, national identity formation, conflicts between religion and science, and global tourism. Questions we will consider in this course: what are the fundamental features of museums as institutions? what ties have linked them to wider national and international communities of academics, NGO’s and business? to political, economic and social concerns? how do museums in Asia, Africa, the Middle East, and Latin America figure in the current international contention over heritage rights? This is an innovative course allowing students to collaborate on projects, engage with guest lecturers and access museums across the globe. The course is organized in three parts: Part I: National Identity Building and Museums; Part II: Museums and Identity Politics; Part III: Museums and Global Development. Offered as HSTY 329, ARTH 301, HSTY 429, and ARTH 401. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 332. European International Relations 1789-1945. 3 Units.

HSTY 333. Reading Capital: Political Economy in the Age of Modern Industry. 3 Units.
Since its first publication in German in 1867, and its appearance in English in 1886, Karl Marx's Capital: A Critique of Political Economy, Volume I, has occupied a seminal position in European thought. Beginning with the presumptions of classical liberal political economy, Marx employed his technique of the materialist dialectic to unmask, in his view, the contradictions and structural limitations that the capitalist mode of production imposed upon capitalists and proletarians alike. Much mentioned, but seldom read, Volume I of Capital remains a crucial window into understanding the intellectual, economic, social, and cultural currents of the 19th century, and its impact extends into the 21st . This course consists of a close, directed reading of the entire text of this volume, combined with discussion, research, and coordinated exploration, so that students can bring this powerful critique to bear on their reading of history and economics in the modern era. Offered as HSTY 333 and HSTY 433. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 334. History of 19th Century Germany. 3 Units.
Examines the political, social, economic, and cultural history of Germany from the late eighteenth century to 1914. Explores the intellectual and social background to the rise of German liberalism and nationalism, the struggle with bureaucratic absolutism, the revolutions of 1848, industrial capitalism and the emergence of a class society, unification under Bismarck, the role of the state, culture, religion, and changes of mentality, the development of mass politics, and the coming of World War I. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 335. History of 20th Century Germany. 3 Units.
Examines the tumultuous history of Germany from 1914 to the unification of the two Germanys in 1989-1990. From the totalizing and traumatic experience of World War I, through a failed revolution, the republican experiment of Weimar, the National Socialist dictatorship under Hitler and the divided Germany suspended between the superpowers, to the newly unified democratic Federal Republic. Examines the ways in which Germans have tried to reconcile the state to their society, economy, and individual lives. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 337. Ancient Medicine. 3 Units.
This course offers a general survey of the history of medicine from its origins in pre-historical times to Galen (2nd c. CE) with a view to gaining a better understanding of the path that eventually lead to modern medical practice. The various medical systems considered, including the ancient Babylonian, Egyptian, Jewish, Chinese, Ayurvedic, Greek and Roman traditions, will be examined through the study of primary and secondary sources, while key conceptual developments and practices are identified within their cultural and social context. Special issues, such as epidemics, women's medicine, and surgery, are also explored and discussed. Offered as CLSC 337, CLSC 437, HSTY 337, and HSTY 437. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 338. History of the American West. 3 Units.
The U.S. West has meant many things throughout American history—early explorers called it the Great American Desert, railroad boosters lured settlers to it by promising to make the arid land bloom into an agricultural Eden, urban immigrants looked to its limitless stretches of land as an escape from industrial labor, children read dime novels that glorified its heroes, and millions of tourists celebrate its raw beauty by visiting Yellowstone, Yosemite, and the Grand Canyon. The West has also been home diverse native societies for thousands of years, Asian immigrants who viewed it as an eastern frontier, women who struggled to feed their children in an arid land, and Latin Americans, whose ancestors often preceded the entry of White Americans. This course introduces students to the themes, questions, and debates central to the study of the American west by drawing in primary source material and scholarly interpretations. The goal of this course is to provide students with an understanding of the human history of the American west and the ability to express that history in clear, passionate writing and in-class discussion. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 339. The Origins of the Arab-Israeli Conflict, 1900-1948. 3 Units.
The British Empire took control of Palestine after driving the Germans and Turks from the region near the end of World War I. From that moment on, the British had an increasingly difficult time administering the region. Jewish colonists had already been settling in the land for decades, and with their takeover, the British gave them and other Zionists reason to believe that the Empire would facilitate Jewish efforts. At the same time, the indigenous Arabs of Palestine appealed to the British to protect their very birthright, to keep their country from passing into someone else's hands. The British gave Arabs, too, reason to believe that they would recognize and defend their claims. In the few decades that the British Mandate governed Palestine it oversaw riots, revolution, and terrorist bombings. When it withdrew from Palestine, its legacy was a brutal war between Arabs and Jews; and the legacy of that war holds an iron grip on the course of world history to this day. Had the British Empire not been in Palestine, and not made the fateful decisions that it did, there would be no Israel and no Arab-Israeli conflict as we know them. Course materials include histories of Zionism, pre-Zionist Palestine, the British Mandate years, the British Empire in other Arab lands, and the 1948 war and aftermath. Primary sources from the perspective British officials on the ground in Palestine receive much attention. The histories of engineering and agriculture are highlighted alongside traditional social and political perspectives. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 340. A History of Workers in the United States. 3 Units.
This course examines the experience of working people in the United States with an emphasis on twentieth-century social movements. It explores the lives of the women and men, skilled and unskilled, and rural and urban laborers that produce the goods and provide the services that society consumes. At crucial moments, working people have created or helped sustain national social movements in an effort to improve some aspect of their lives. We therefore will assess laborers in relation to several known and less known American social movements, such as the eight-hour day movement during the late nineteenth century, the peace movement during WWI, and the Civil Rights movement in the wake of WWII. Throughout the course we will also discuss the politics of time-managed work, the influence of public policy and government institutions; the role of unions within a competitive market economy; the relationship between industrial economies and functional blue-collar communities; and the correlation between immigration and globalization. Offered as HSTY 340, HSTY 430 and ETHS 340. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 341. Jewish Urban History. 3 Units.
This course examines the relationship between Jews and the modern urban environment. It seeks to answer questions such as: How did the modernization of cities affect Jews and Jewish communities? In what ways did Jews contribute to modern urban cultural and social forms? What is Jewish urban space, is it unique, and how is it remembered later on? Are there differences between the patterns in Europe, the Middle East, and the Americas? Offered as HSTY 341 and JDST 341. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 342. Water. 3 Units.
This seminar will explore the history of the meaning of water—which is, the social, cultural, and/or political significance placed on water by individuals and governments in different times and places. It will also examine how humans have acted upon water, and how it has acted upon humans, with great consequences for human life. This seminar will look at the history of water in the context of science, technology and society; public health; political science; and environmental history. Case studies will be drawn from a wide chronological and geographical range; from the ancient world to Renaissance Italy, nineteenth century India, modern Britain, Egypt, and the U.S. The course provides a wide perspective on the themes of the history of human-water interactions, but will also focus closely on some critical cases. Seminar participants will write a research paper on the topic of their choice in the environmental history of water. Offered as: HSTY 342, HSTY 442, POSC 342 and POSC 442. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 345. The European City. 3 Units.
An examination of architectural, social, cultural, philosophical, political, and economic aspects of life in European cities. The principle focus will be the transition of medieval and early modern cities to modern metropolises, both spatially and socially. An additional theme will be urban development and concomitant social questions in non-European cities that were built either to serve expatriate Europeans or to emulate European modernity. Case studies may include London, Paris, Berlin, Vienna, Moscow, the provincial and national capitals of East-Central Europe, and cities in Africa, Asia, and Latin America. Offered as HSTY 345 and HSTY 445. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 346. Guns, Germs, and Steel. 3 Units.
Jared Diamond's Guns, Germs, and Steel won the Pulitzer for non-fiction in 1998. Diamond, a physiologist, explains that Western Europe came to occupy and dominate large areas of the globe because of natural resources present in certain regions of the Old World since the end of the last Ice Age. Where a historian might look for answers in the written evidence left by historical individuals, Diamond examines ancient patterns of plant diffusion or the place of mountain ranges and deserts in the development of technologies. This seminar is about applying the history of a specific time and place namely North America from European contact to 1850 - to Diamond's general environmental explanations and models. Placing Diamond's broad explanations within specific historical contexts is revealing. A range of alternative methods, perspectives, primary sources from North America, and case studies (especially within environmental history) help develop a critical understanding of the complexities of European expansion into the New World. The course explores an extended comparative exploration of the worldviews of different world cultures, most extensively comparing European worldviews with Native American, but also paying significant attention to Asian worldviews. The Native American cultures under consideration include those of both North and South America. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 348. History of Modern Political and Social Thought. 3 Units.
This course explores the responses of philosophers, economic theorists, culture critics, and public policy makers to changes in western society wrought by industrialization by focusing on their concerns with technological change. Offered as HSTY 348, HSTY 448 and POSC 348.

HSTY 351. Colonial America 1607-1763. 3 Units.
The formative years of American society and culture. Slavery and racism, expansionism, regionalism, the family, pluralism, sense of mission, and republican ideology.

HSTY 352. The Era of the American Revolution, 1763 - 1789. 3 Units.
This is an intensive survey of the Revolutionary period of American history, from the end of the French and Indian War in 1763 to the ratification of the U.S. Constitution in 1789, focusing especially on the underlying causes of the American Revolution, the chain of events leading to the Declaration of Independence, the war with England, the Constitutional Convention, and the ratification struggle that followed, with some background on the earlier period (1607-1763).

HSTY 353. Women in American History I. 3 Units.
The images and realities of women's social, political, and economic lives in early America. Uses primary documents and biographers to observe individuals and groups of women in relation to legal, religious, and social restrictions. Offered as HSTY 353, WGST 353, and HSTY 453. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 354. Women in American History II. 3 Units.
With HSTY 353, forms a two-semester introduction to women's studies. The politics of suffrage and the modern woman's efforts to balance marriage, motherhood, and career. (HSTY 353 not a prerequisite.) Offered as HSTY 354, WGST 354, and HSTY 454. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 355. Age of American Civil War 1815-80. 3 Units.
This course examines the causes and consequences of the Civil War, focusing on the rise of sectionalism, the dynamics of conflict, and reconstruction. Heavy emphasis is placed on archival research in relevant first-person accounts from the period.

HSTY 356. Industrial America: 1880-1940. 3 Units.
This course will explore the history of the United States from 1880 to 1940 as the nation organized itself into a modern industrial society. We will examine the rise of a corporate and technological society, the development of cities and urban problems, the growth of government, and the way in which immigrants, women, and African-Americans negotiated a shifting social organization. This class will also focus on the growing dominance of consumerism and the cultural and intellectual critique of the changes that occurred during these events.

HSTY 358. America Since 1940. 3 Units.
This course will focus on the political, social, cultural, and economic changes that took place in the United States in the period spanning from the Great Depression to the present. Throughout the course, we will examine the challenges of pluralism, the position of the U.S. in the world, and the particular ways in which domestic conflict over such matters has shaped the contemporary United States.

HSTY 359. Books as Bombs: Books that Reshaped American Culture. 3 Units.
Every now and again a piece of prose profoundly reshapes American society and culture. In this advanced undergraduate seminar, students will read and discuss a selection of such works under the tutelage of Professors Shulman, a specialist in the History of Science and Technology, and Sentilles, who specializes in social and cultural history. The professors will set up the context of the work's publication or creation and then lead the class in a lively dissection of both the work and its impact. The main question asked of each book is "how and why did this work have such an effect?" In attempting to answer that question, students will come to a greater understanding of society that created and then responded to each work. Offered as HSTY 359 and HSTY 459. Counts as SAGES Departmental Seminar.

HSTY 361. Crime and Culture in Early America. 3 Units.
This course explores the intersection of crime, punishment, and popular culture in colonial British America and the early United States through 1860 by closely examining a series of popular crime genres, including execution sermons, criminal conversion narratives, criminal autobiographies, and trial reports. Readings in modern scholarship—drawing on several disciplines—will shed light on the popular literature and on underlying patterns of crime and punishment, while students will critically evaluate modern scholarly interpretations in light of the early crime publications. Types of crimes explored in the readings include witchcraft, piracy, burglary, robbery, and various types of murder, such as infanticide, familicide (cases of men murdering their wives and children), and sexual homicide. Each student will write several short analytical papers drawn from the shared readings and, at the end of the semester, produce an independent research paper. Offered as HSTY 361 and HSTY 461.

HSTY 363. Gender and Sexuality in America. 3 Units.
This multicultural seminar uses a mixture of historical text, gender theory, personal biography, and artistic expression to explore changing notions of gender and sexuality over the past two centuries in the United States. Offered as HSTY 363, HSTY 463 and WGST 363. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 366. Science, Technology, and Government. 3 Units.
Traces the development and influence of federal technology and science policies from colonial times to the present, with emphasis on the 20th century. Offered as HSTY 366 and POSC 365.

HSTY 371. Jews under Islam and Christianity. 3 Units.
This course examines the social and political status of Jews under Muslim and Christian rule since the Middle Ages. Themes include interfaith relations, Islamic and Christian beliefs regarding the Jews, Muslim and Christian regulation of Jewry, and the Jewish response. Offered as HSTY 371, JDST 371 and RLGN 371. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 373. Women and Medicine in the United States. 3 Units.
Students in this seminar will investigate the experiences of American women as practitioners and as patients. We will meet weekly in the Dittrick Medical Museum for discussion of texts and use artifacts from the museum's collection. After a unit exploring how the female body was viewed by medical theorists from the Galenic period to the nineteenth-century, we will look at midwives, college-trained female doctors and nurses, and health advocacy among poor populations. We will then look at women's experiences in terms of menstruation, childbearing, and menopause, before exploring the cultural relationship between women and psychological disorders. Offered as HSTY 373, HSTY 473, and WGST 373. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 378. North American Environmental History. 3 Units.
This course introduces major questions and approaches in the study of environmental history. Taking North America as our subject, we explore how humans have shaped the environment of the continent and how human history has, in turn been shaped by the natural world form antiquity to the present. Major topics include Pleistocene extinctions, the Columbian exchange, the market revolution in agriculture, American epidemics, industrialization, the origins of conservation, the environmental movement, and the globalization of America’s environmental footprint. Offered as HSTY 378 and HSTY 468.

HSTY 380. The Sixties in America. 3 Units.
This course examines social, cultural, and political changes in the United States during the 1960s. We begin by examining the economic prosperity and “fragile” political consensus of the post-WWII period, as well as the undercurrent of poverty, dissent, and Cold War fears. We then cover the civil rights movements, student activism, the women’s movement, the growth of Liberal America and the welfare state, the Vietnam War, the counterculture and conservative youth movements, the growth of a national consumer-driven, mass-mediated market, and the music, art, and pop culture— as well as their growing reliance on technological intervention— during this period of creative efflorescence. We will do this through reading books, but also through “reading” contemporary evidence of life in America, including listening to music, viewing films, analyzing pictures and artifacts.

HSTY 381. City as Classroom. 3 Units.
In this course, the city is the classroom. We will engage with the urban terrain. We will meet weekly off-campus, interact with community members, and interface— both literally and figuratively— with the city as a way to examine the linkages between historical, conceptual, and contemporary issues, with particular attention paid to race and class dynamics, inequality, and social justice. This course will have four intersecting components, primarily focusing on American cities since the 1930s: the social and physical construction of urban space, the built environment, life and culture in the city, and social movements and grassroots struggles. Offered as HSTY 381, POSC 381, SOCI 381, HSTY 481, POSC 481, and SOCI 481. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 383. Readings in PRC History. 3 Units.
This course examines the historiography of several key issues in the history of the People’s Republic of China. Although the emphasis will be to explore at greater length and greater detail specific topics in post-1949 Chinese social, cultural, and political history, some topics will incorporate key historiographic works addressing the pre-1949 period as a point of comparison. We will explore the major historical transformations that led to a political break from China’s imperial past, and we will examine both the continuities and discontinuities shaping China’s experience as a modern nation during the latter half of the 20th century. Major themes covered include: the origins of the Chinese revolution, the Great Leap Forward, Cultural Revolution, rural-urban divide, the one-child policy, socialism with Chinese characteristics, et al. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 385. Readings in Society and Culture in Modern Chinese History. 3 Units.
The primary goal of this course is to provide students an opportunity to explore at greater length specific topics in Chinese social and cultural history. The period covered by the assigned readings roughly spans the late eighteenth century through the first half of the twentieth century. Readings will cover a wide range of topical themes, including childhood, gender and sexuality, urban life, print media, religion, and the environment. Offered as HSTY 385 and HSTY 485. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 387. Growing Up in America: 1607 - 2000. 3 Units.
Children have been growing up in the United States since it was declared independent, in 1776, but how adults conceive of (and therefore legislate and interpret) children and childhood constantly changes to fit current circumstances. The experiences of children themselves have varied not only in terms of race, class, gender, and religion but also depending on specific events (i.e., coming of age during the Civil War versus the Civil Rights movement) or geography (i.e., growing up in rural Hawaii vs. urban New Jersey). We cannot cover all of those histories in one course, so this seminar course instead focuses on exploring the interplay of ideas about children and the expressed or historical experiences of children. When the puritans and plantations members (slave, bonded and free) came to the Atlantic shore, they brought with them particular ideas about what is meant to be a child, and to experience childhood. They encountered already established residents who also had ideas about childhood. How did those concepts adjust/meld/contrast over time, and how do we see those ideas reflected or reshaped by actual experiences? This course engages particular lines of inquiry: How and why do understanding about what is “natural” for children change over time? How do variables like race, class, gender, etc., uphold effects the manifesting of such concepts? What is the role of the state in children’s lives and how has that changed over time? What is the impact of mass culture on modern childhood? Counts for CAS Global & Cultural Diversity Requirement.

HSTY 389. History of Zionism. 3 Units.
This course seeks to elucidate the major strands of Zionism, their origins, how they have interacted, and their impact on contemporary Israeli society. These may include political Zionism, cultural Zionism, socialist (labor) Zionism, Revisionist Zionism, and religious Zionism. This course will also examine the differences in the appeal of Zionism to Jews in different places, such as Western Europe, Eastern Europe and the United States. Offered as HSTY 389 and JDST 389. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 390. Senior Research Seminars in History and Philosophy of Science. 3 Units.
Directed independent research seminar for seniors who are majors in the History and Philosophy of Science program. The goal of the course is to develop and demonstrate command of B.A.-level factual content, methodologies, research strategies, historiography, and theory relevant to the field of history of science and/or philosophy of science. The course includes both written and oral components. Offered as HSTY 380 and PHIL 390. Counts as SAGES Senior Capstone.
HSTY 391. Food in History. 3 Units.
Food is inextricably interconnected with the development of agriculture and other technologies, with the rise and fall of empires, with increasing understanding of diet and nutrition, with laws and regulations, with the arts, with economic development and consumer culture, and with religious and ethnic identities. By examining selective and representative episodes pertaining to each of these topics, this course explores the global history of food, from the agricultural revolution of the neolithic era to the consumer revolution of the last generation. Offered as HSTY 391 and HSTY 491.

HSTY 393. Advanced Readings in the History of Race. 3 Units.
This course examines the concept of race as a social construction that carries political and economic implications. We begin by examining the histories of the early racial taxonomists (e.g., Bernier, Linnaeus, and Blumenbach among others) and the contexts that informed their writings. We then assess how the concept of race changed from the nineteenth to the twentieth century in the United States. We conclude by evaluating how the ideology of race has influenced U.S. domestic life and foreign policy at specific historical moments. Offered as HSTY 393, HSTY 493, and ETHS 393. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 395. History of Medicine. 3 Units.
This course treats selected topics in the history of medicine, with an emphasis on social and cultural history. Focusing on the modern period, we examine illnesses, patients, and healers, with attention to the ways sickness and medicine touch larger questions of politics, social relations and identity. Offered as HSTY 395 and HSTY 495.

HSTY 396. Advanced Topics in History. 3 Units.
Advanced topics in history, changing from semester to semester. The course provides students an opportunity to explore special themes or theoretical issues in history that are too briefly covered in broader surveys. Students may take this course more than once for credit, when different topics are covered. Offered as HSTY 396 and HSTY 496.

HSTY 397. Undergraduate Tutorial. 1 - 3 Units.
Individual instruction with members of the history faculty. Recommended preparation: 12 hours of History.

HSTY 398. Senior Research Seminar. 3 Units.
Training in the nature and methods of historical writing and research. Counts as SAGES Senior Capstone. Prereq: Majors only, Senior standing.

HSTY 399. Advanced Readings in Black History. 3 Units.
This is an advanced readings course that may change from semester to semester. This course will provide students with an opportunity to more deeply explore special themes and theoretical issues in the field of black history that are often quickly and briefly covered in broad survey courses. Readings may be organized around specific topics such as resistance and social protest, black intellectual history, black nationalism and identity, black film and historical literacy black cultural forms and politics, black urban history, or some such other combination. Students may take this course more than once and receive credit as long as the course topic differs. Students should contact the History Department for more details on course content during any given semester. Offered as ETHS 391, HSTY 399 and HSTY 499.

HSTY 400. Graduate Topical Seminar. 3 Units.
A rotating graduate seminar, offered every semester by a different faculty member. Each semester focuses on a topic of central historiographical or methodological importance. Prereq: Graduate standing or instructor permission.

HSTY 402. Introduction to Historiography of Science. 3 Units.
A graduate-level historiographic review of the history of the sciences from the seventeenth century to the present. Prereq: Graduate standing or instructor permission.

HSTY 404. Introduction to the Nonprofit Sector. 3 Units.
The United States has by far the largest and most important "nonprofit sector" in the world, a sector consisting of voluntary non-governmental organizations that provide health care, education and social services as well as arts, religious, and advocacy activities. Using mostly primary sources, this course considers the significance of the nonprofit sector in the U.S., its advantages and disadvantages, its uses for different groups of Americans, and current trends. Students have the option of writing either a standard term paper, or a study of strategic challenges facing a contemporary nonprofit organization. Offered as HSTY 204 and HSTY 404. Counts as SAGES Departmental Seminar. Prereq: Graduate standing or instructor permission.

HSTY 406. History of Museums: Theory and Reality. 3 Units.
This course is an intensive summer internship (10 hours per week) at the Western Reserve Historical Society, complemented by extensive readings in museum/archival theory and public historical perception. It is designed both to introduce students to museum/archival work and to compare theoretical concepts with actual museum situations. Interns will be assigned a specific project within one of the Society’s curatorial or administrative divisions, but will have the opportunity to work on ancillary tasks throughout the Historical Society’s headquarters in University Circle. Offered as HSTY 306 and HSTY 406. Prereq: Graduate standing or instructor permission.

HSTY 407. Development of Chemistry and Chemical Engineering. 3 Units.
The development of chemical ideas; theories of matter, composition, structure, and reaction; the application of chemistry and chemical theory from antiquity to the 20th century; all considered in social context. Recommended preparation: One year of college chemistry. Offered as HSTY 307 and HSTY 407.

HSTY 410. Seminar: Early American Historiography. 3 Units.
This seminar examines the historiography of early America. It is designed to acquaint history doctoral students with the major themes, methods, and scholars of American history from the seventeenth century to the mid-nineteenth century. Students will be expected to read and report on major works in the field. Prereq: Graduate standing or instructor permission.

HSTY 411. Seminar: Modern American Historiography. 3 Units.
This seminar examines the approaches that professional historians of the United States have taken to the writing of American history in the past fifty years, with emphasis on changes in historical concerns, master debates among historians, and contemporary interests. Topics covered include national politics and government, economic development, social history, the history of ethnicity, race, and gender, and foreign policy and international relations. Each student will read widely and will prepare a series of reports on selected books and authors. Offered as HSTY 311 and HSTY 411. Prereq: Graduate standing or instructor permission.
HSTY 420. Alexander the Great: Materials and Methods. 3 Units.
This course is the Classics Departmental Seminar in the SAGES sequence (normally taken in the Spring semester of a major's Junior year), though it can also be taken for regular credit in Classics or History by both undergraduate and graduate students. The seminar offers students a firm grounding in the discipline of Classics with an emphasis on the diverse materials (particularly primary source material), methods and approaches that can be brought to bear on the study of Greco-Roman antiquity. Students will read and discuss the ancient sources and contemporary scholarship on the enigmatic Alexander the Great drawn from various fields of classics, including history, archaeology, art history, philosophy, gender studies, epigraphy, numismatics, and the reception of Alexander. Based upon this, they will then write a research paper that employs conventions found in the field of Classics. Much of this training, however, will also be transferable to other fields and periods. Because the scope of the seminar moves (along with Alexander himself) beyond Europe and examines the historical foundations of the antagonism between East and West, this course qualifies as a Global and Cultural Diversity course. Offered as CLSC 420, HSTY 320 and HSTY 420. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 427. Comparative Environmental History. 3 Units.
Environmental history is the study of how humans have influenced the environments around them and how the environment itself has influenced the course of human societies. This course provides students with the skill to identify and analyze these interactions. It introduces course participants to the main themes of environmental history literature and the driving questions guiding environmental history research by examining case studies drawn around the globe, including Pre-Columbian America, Medieval Japan, Colonial Africa, and Modern Germany. This course will help course participants recognize the important patterns and developments that have led to present day human-environmental relationships. Offered as HSTY 327 and HSTY 427. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing or instructor permission.

HSTY 428. Comparative Perspectives on Museum and Archive History and Practice. 3 Units.
Comparative Perspectives on Archives and Museum History and Practice is a distance learning based course shared with students at Bilkent University in Ankara, Turkey. The course focuses on a comparison of the history and development of archives and museums in the United States and in late Ottoman and Republican Turkey. Topics considered include the "ownership" of culture; state vs. private control of heritage; marketing of museums; and the impact of evolving technologies on the presentation and preservation of culture. Students work together via a shared, live lecture format. In addition to the instructor, museum and archive professionals from both the US and Turkey provide lectures and lead discussions during the semester. The primary intellectual product of the course is a final paper/project which compares the history, operational structure, and mission of a museum/archive in the US with a similar institution in Turkey. The paper/project is created by collaborative effort between a student at CWRU and one at Bilkent. Provided grant funding is available, the course may involve exchange visits to Turkey and the US. Offered as HSTY 328 and HSTY 428. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 429. Museums and Globalization. 3 Units.
Museums are everywhere contested spaces today. Historically designed as symbols of power, centers for research, agents of public education and community formation in Western industrial societies, they have become sites of development and cultural controversy on a global scale. From Cleveland and Paris to Nairobi and Dubai museums figure in urban redevelopment, national identity formation, conflicts between religion and science, and global tourism. Questions we will consider in this course: what are the fundamental features of museums as institutions? what ties have linked them to wider national and international communities of academics, NGO's and business? to political, economic and social concerns? how do museums in Asia, Africa, the Middle East, and Latin America figure in the current international contention over heritage rights? This is an innovative course allowing students to collaborate on projects, engage with guest lecturers and access museums across the globe. The course is organized in three parts: Part I: National Identity Building and Museums; Part II: Museums and Identity Politics; Part III: Museums and Global Development. Offered as HSTY 329, ARTH 301, HSTY 429, and ARTH 401. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing or instructor permission.

HSTY 430. A History of Workers in the United States. 3 Units.
This course examines the experience of working people in the United States with an emphasis on twenty-first-century social movements. It explores the lives of the women and men, skilled and unskilled, and rural and urban laborers that produce the goods and provide the services that society consumes. At crucial moments, working people have created or helped sustain national social movements in an effort to improve some aspect of their lives. We therefore will assess laborers in relation to several known and less known American social movements, such as the eight-hour day movement during the late nineteenth century, the peace movement during WWI, and the Civil Rights movement in the wake of WWII. Throughout the course we will also discuss the politics of time-managed work; the influence of public policy and government institutions; the role of unions within a competitive market economy; the relationship between industrial economies and functional blue-collar communities; and the correlation between immigration and globalization. Offered as HSTY 340, HSTY 430 and ETHS 340. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 433. Reading Capital: Political Economy in the Age of Modern Industry. 3 Units.
Since its first publication in German in 1867, and its appearance in English in 1886, Karl Marx's Capital: A Critique of Political Economy, Volume I, has occupied a seminal position in European thought. Beginning with the presumptions of classical liberal political economy, Marx employed his technique of the materialist dialectic to unmask, in his view, the contradictions and structural limitations that the capitalist mode of production imposed upon capitalists and proletarians alike. Much mentioned, but seldom read, Volume I of Capital remains a crucial window into understanding the intellectual, economic, social, and cultural currents of the 19th century, and its impact extends into the 21st. This course consists of a close, directed reading of the entire text of this volume, combined with discussion, research, and coordinated exploration, so that students can bring this powerful critique to bear on their reading of history and economics in the modern era. Offered as HSTY 333 and HSTY 433. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 437. Ancient Medicine. 3 Units.
This course offers a general survey of the history of medicine from its origins in pre-historical times to Galen (2nd c. CE) with a view to gaining a better understanding of the path that eventually lead to modern medical practice. The various medical systems considered, including the ancient Babylonian, Egyptian, Jewish, Chinese, Ayurvedic, Greek and Roman traditions, will be examined through the study of primary and secondary sources, while key conceptual developments and practices are identified within their cultural and social context. Special issues, such as epidemics, women's medicine, and surgery, are also explored and discussed. Offered as CLSC 337, CLSC 437, HSTY 337, and HSTY 437. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 440. Science and Society Through Literature. 3 Units.
This course will examine the interaction of scientific investigation and discovery with the society it occurred in. What is the effect of science on society and, importantly, what is the effect of society on science? An introduction will consider the heliocentric controversy with focus on Galileo. Two broad areas, tuberculosis and the Frankenstein myth, will then be discussed covering the period 1800-present. With tuberculosis, fiction, art and music will be examined to understand the changing views of society towards the disease, how society's perception of tuberculosis victims changed, and how this influenced their treatments and research. With Frankenstein, the original novel in its historical context will be examined. Using fiction and film, the transformation of the original story into myth with different connotations and implications will be discussed. Most classes will be extensive discussions coupled with student presentations of assigned materials. Offered as PHRM 340, BETH 440, PHRM 440, and HSTY 440.

HSTY 442. Water. 3 Units.
This seminar will explore the history of the meaning of water—that is, the social, cultural, and/or political significance placed on water by individuals and governments in different times and places. It will also examine how humans have acted upon water, and how water has acted upon humans, with great consequences for human life. This seminar will look at the history of water in the context of science, technology and society; public health; political science; and environmental history. Case studies will be drawn from a wide chronological and geographical range; from the ancient world to Renaissance Italy, nineteenth century India, modern Britain, Egypt, and the U.S. The course provides a wide perspective on the themes of the history of human-water interactions, but will also focus closely on some critical cases. Seminar participants will write a research paper on the topic of their choice in the environmental history of water. Offered as: HSTY 342, HSTY 442, POSC 342 and POSC 442. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 445. The European City. 3 Units.
An examination of architectural, social, cultural, philosophical, political, and economic aspects of life in European cities. The principle focus will be the transition of medieval and early modern cities to modern metropolises, both spatially and socially. An additional theme will be urban development and concomitant social questions in non-European cities that were built either to serve expatriate Europeans or to emulate European modernity. Case studies may include London, Paris, Berlin, Vienna, Moscow, the provincial and national capitals of East-Central Europe, and cities in Africa, Asia, and Latin America. Offered as HSTY 345 and HSTY 445. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 448. History of Modern Political and Social Thought. 3 Units.
This course explores the responses of philosophers, economic theorists, culture critics, and public policy makers to changes in western society wrought by industrialization by focusing on their concerns with technological change. Offered as HSTY 348, HSTY 448 and POSC 348.

HSTY 451. History of European Technology. 3 Units.
A graduate-level, research seminar on the history of European technology from the Industrial Revolution to the present. Special emphasis is on cultural history of technology with a transatlantic view. The themes of the seminar vary from year to year, but include: communications, industrialization, control, cultural and intellectual approaches to the history of technology. Required work includes a research paper based on original sources. Prereq: Graduate standing or instructor permission.

HSTY 452. Readings in the History of American Technology. 3 Units.
A graduate-level review of the history of American technology. Prereq: Graduate standing or instructor permission.

HSTY 453. Women in American History I. 3 Units.
The images and realities of women's social, political, and economic lives in early America. Uses primary documents and biographers to observe individuals and groups of women in relation to legal, religious, and social restrictions. Offered as HSTY 353, WGST 353, and HSTY 453. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing or instructor permission.

HSTY 454. Women in American History II. 3 Units.
With HSTY 353, forms a two-semester introduction to women's studies. The politics of suffrage and the modern woman's efforts to balance marriage, motherhood, and career. (HSTY 353 not a prerequisite.) Offered as HSTY 354, WGST 354, and HSTY 454. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing or instructor permission.

HSTY 459. Books as Bombs: Books that Reshaped American Culture. 3 Units.
Every now and again a piece of prose profoundly reshapes American society and culture. In this advanced undergraduate seminar, students will read and discuss a selection of such works under the tutelage of Professors Shulman, a specialist in the History of Science and Technology, and Sentilles, who specializes in social and cultural history. The professors will set up the context of the work's publication or creation and then lead the class in a lively dissection of both the work and its impact. The main question asked of each book is "how and why did this work have such an effect?" In attempting to answer that question, students will come to a greater understanding of society that created and then responded to each work. Offered as HSTY 359 and HSTY 459. Counts as SAGES Departmental Seminar.
HSTY 461. Crime and Culture in Early America. 3 Units.
This course explores the intersection of crime, punishment, and popular culture in colonial British America and the early United States through 1860 by closely examining a series of popular crime genres, including execution sermons, criminal conversion narratives, criminal autobiographies, and trial reports. Readings in modern scholarship—drawing on several disciplines—will shed light on the popular literature and on underlying patterns of crime and punishment, while students will critically evaluate modern scholarly interpretations in light of the early crime publications. Types of crimes explored in the readings include witchcraft, piracy, burglary, robbery, and various types of murder, such as infanticide, familicide (cases of men murdering their wives and children), and sexual homicide. Each student will write several short analytical papers drawn from the shared readings and, at the end of the semester, produce an independent research paper. Offered as HSTY 361 and HSTY 461. Prereq: Graduate standing or instructor permission.

HSTY 463. Gender and Sexuality in America. 3 Units.
This multicultural seminar uses a mixture of historical text, gender theory, personal biography, and artistic expression to explore changing notions of gender and sexuality over the past two centuries in the United States. Offered as HSTY 363, HSTY 463 and WGST 363. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 468. North American Environmental History. 3 Units.
This course introduces major questions and approaches in the study of environmental history. Taking North America as our subject, we explore how humans have shaped the environment of the continent and how human history has, in turn, been shaped by the natural world form antiquity to the present. Major topics include Pleistocene extinctions, the Columbian exchange, the market revolution in agriculture, American epidemics, industrialization, the origins of conservation, the environmental movement, and the globalization of America's environmental footprint. Offered as HSTY 378 and HSTY 468. Prereq: Graduate standing or instructor permission.

HSTY 470. Historiography, Method, and Theory. 3 Units.
A graduate level survey of fundamental themes in historiography, method, and theory, as well as interdisciplinary methods and theories. Prereq: Graduate standing or instructor permission.

HSTY 473. Women and Medicine in the United States. 3 Units.
Students in this seminar will investigate the experiences of American women as practitioners and as patients. We will meet weekly in the Dittrick Medical Museum for discussion of texts and use artifacts from the museum's collection. After a unit exploring how the female body was understood in the eighteenth century, we will look at midwives, college-trained female doctors and nurses, and health advocacy among poor populations. We will then look at women's experiences in terms of menstruation, childbearing, and menopause, before exploring the cultural relationship between women and psychological disorders. Offered as HSTY 373, HSTY 473, and WGST 373. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing or instructor permission.

HSTY 476. Seminar in Comparative History. 3 Units.
An introduction to comparative method for historians. The topics will vary year to year, but the course will require exposure to historical contexts outside of the United States. Prereq: Graduate standing or instructor permission.

HSTY 477. Modern Policy History of the United States. 3 Units.
This course offers a historical perspective on policy and policy making in the United States since the late nineteenth century. It emphasizes the increasing role of the federal government, the persisting importance of the states, the significance of the courts, the revolutionary impact of the women's and civil rights movements, and the consequences of the growth and transformation of the American economy. Each student selects a policy area for detailed exploration; students often choose topics related to civil rights, women's rights, health care, environmental reform, non-profit and non-governmental organizations, the arts, and education, but other topics are also appropriate. Prereq: Graduate standing or instructor permission.

HSTY 479. Historical Research and Writing. 3 Units.
Research seminar for graduate students. Intensive focus on processes of historical research and writing. Students produce conference paper and research paper based on primary sources. Prereq: Graduate standing or instructor permission.

HSTY 481. City as Classroom. 3 Units.
In this course, the city is the classroom. We will engage with the urban terrain. We will meet weekly off-campus, interact with community members, and interface—both literally and figuratively—with the city as a way to examine the linkages between historical, conceptual, and contemporary issues, with particular attention paid to race and class dynamics, inequality, and social justice. This course will have four intersecting components, primarily focusing on American cities since the 1930s: the social and physical construction of urban space, the built environment, life and culture in the city, and social movements and grassroots struggles. Offered as HSTY 381, POSC 381, SOCI 381, HSTY 481, POSC 481, and SOCI 481. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 485. Readings in Society and Culture in Modern Chinese History. 3 Units.
The primary goal of this course is to provide students an opportunity to explore at greater length specific topics in Chinese social and cultural history. The period covered by the assigned readings roughly spans the late eighteenth century through the first half of the twentieth century. Readings will cover a wide range of topical themes, including childhood, gender and sexuality, urban life, print media, religion, and the environment. Offered as HSTY 385 and HSTY 485. Counts for CAS Global & Cultural Diversity Requirement.

HSTY 491. Food in History. 3 Units.
Food is inextricably interconnected with the development of agriculture and other technologies, with the rise and fall of empires, with increasing understanding of diet and nutrition, with laws and regulations, with the arts, with economic development and consumer culture, and with religious and ethnic identities. By examining selective and representative episodes pertaining to each of these topics, this course explores the global history of food, from the agricultural revolution of the neolithic era to the consumer revolution of the last generation. Offered as HSTY 391 and HSTY 491. Prereq: Graduate standing or instructor permission.

HSTY 493. Advanced Readings in the History of Race. 3 Units.
This course examines the concept of race as a social construction that carries political and economic implications. We begin by examining the histories of the early racial taxonomists (e.g., Bernier, Linnaeus, and Blumenbach among others) and the contexts that informed their writings. We then assess how the concept of race changed from the nineteenth to the twentieth century in the United States. We conclude by evaluating how the ideology of race has influenced U.S. domestic life and foreign policy at specific historical moments. Offered as HSTY 393, HSTY 493, and ETHS 393. Counts for CAS Global & Cultural Diversity Requirement.
HSTY 495. History of Medicine. 3 Units.
This course treats selected topics in the history of medicine, with an emphasis on social and cultural history. Focusing on the modern period, we examine illnesses, patients, and healers, with attention to the ways sickness and medicine touch larger questions of politics, social relations and identity. Offered as HSTY 395 and HSTY 495. Prereq: Graduate standing or instructor permission.

HSTY 496. Advanced Topics in History. 3 Units.
Advanced topics in history changing from semester to semester. The course provides students an opportunity to explore special themes or theoretical issues in history that are too briefly covered in broader surveys. Students may take this course more than once for credit, when different topics are covered. Offered as HSTY 396 and HSTY 496.

HSTY 497. Graduate Independent Study. 1 - 3 Units.
Independent reading and research programs with individual members of the faculty.

HSTY 499. Advanced Readings in Black History. 3 Units.
This is an advanced readings course that may change from semester to semester. This course will provide students with an opportunity to more deeply explore special themes and theoretical issues in the field of black history that are often quickly and briefly covered in broad survey courses. Readings may be organized around specific topics such as resistance and social protest, black intellectual history, black nationalism and identity, black film and historical literacy black cultural forms and politics, black urban history, or some such other combination. Students may take this course more than once and receive credit as long as the course topic differs. Students should contact the History Department for more details on course content during any given semester. Offered as ETHS 391, HSTY 399 and HSTY 499. Prereq: Graduate standing or instructor permission.

HSTY 525. Intellectual Property and the Construction of Authorship. 3 Units.
Study of the concepts, laws, norms, and practices through which writers and other creative producers establish "property" in their work. Offered as ENGL 525 and HSTY 525. Prereq: Graduate standing or permission.

HSTY 601. Independent Studies. 1 - 18 Units.
(Credit as arranged.)

HSTY 651. Thesis M.A.. 1 - 18 Units.
(Credit as arranged.)

HSTY 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Limited to Ph.D. candidates actively engaged in the research and writing of their dissertations. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

History and Philosophy of Science Program

Clark Hall 203
www.case.edu/artsci/hpst
Phone: 216.368.2632
Colin McLarty, Program Director
colin.mclarty@case.edu

The Department of Philosophy and the Department of History together offer an undergraduate major in the history and philosophy of science. The purpose of the major is to develop a humanistic understanding of the nature and development of science through the combined use of philosophical and historical methods. The major provides a foundation for graduate study in a range of academic disciplines and for careers in such areas as business, medicine, law, public policy, and science journalism. It also may be profitably combined with a program in one of the sciences. Within the major, a student may seek an emphasis on the philosophy of science, the history of the physical sciences, or the history of the biological and medically related sciences.

Undergraduate Programs

Major
The history and philosophy of science major requires 30 credit hours from courses in philosophy and in history of science and technology.

Any four of the following seven classes: 12

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>PHIL 101</td>
<td>Introduction to Philosophy</td>
</tr>
<tr>
<td>HSTY 151</td>
<td>Technology in European Civilization</td>
</tr>
<tr>
<td>HSTY 201</td>
<td>Science in Western Thought I</td>
</tr>
<tr>
<td>HSTY 202</td>
<td>Science in Western Thought II</td>
</tr>
<tr>
<td>HSTY/PHIL 203</td>
<td>Revolutions in Science</td>
</tr>
<tr>
<td>PHIL 204/ HSTY 207</td>
<td>Philosophy of Science</td>
</tr>
<tr>
<td>PHIL 302</td>
<td>Modern Philosophy</td>
</tr>
<tr>
<td>HSTY/PHIL 390</td>
<td>Senior Research Seminars in History and Philosophy of Science</td>
</tr>
</tbody>
</table>

Five electives approved by the major advisor 3

Total Units 15

Students who major in the history and philosophy of science are not permitted to take a second major in philosophy or to minor in philosophy.

Minor
Students who minor in history and philosophy of science are required to complete 15 credit hours, as follows:

Any three of the following five classes: 9

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>PHIL 101</td>
<td>Introduction to Philosophy</td>
</tr>
<tr>
<td>HSTY 202</td>
<td>Science in Western Thought II</td>
</tr>
<tr>
<td>HSTY/PHIL 203</td>
<td>Revolutions in Science</td>
</tr>
<tr>
<td>HSTY 207/ PHIL 204</td>
<td>Philosophy of Science</td>
</tr>
<tr>
<td>PHIL 302</td>
<td>Modern Philosophy</td>
</tr>
</tbody>
</table>

Two electives approved by the minor advisor 6

Total Units 15

Department Faculty
Colin McLarty, PhD
Truman P. Handy Professor of Philosophy, Department of Philosophy; Director, History and Philosophy of Science Program

James M. Edmonson, PhD
Adjunct Associate Professor, Department of History; Director, Dittrick Medical History Center

Chris Haufe, PhD
Associate Professor, Department of Philosophy

Miriam R. Levin, PhD
Henry Eldridge Bourne Professor of History, Department of History
Jonathan Sadowsky, PhD
Theodore J. Castele Professor, Department of History

International Studies Program

111 Mather House
http://arts.ccase.edu/international-studies/
Phone: 216.368.5565; Fax: 216.368.4681
Kelly McMann, Program Director
kelly.mcmann@case.edu

By completing a major in international studies, students develop expertise in a region of the world, including one of its languages, and in a transnational topic. They also become familiar with a variety of international issues and frameworks. They use this expertise and knowledge to understand and analyze the dynamics and complexity of the human world.

Popular transnational topics include international security and diplomacy, global environment, international development, global health, international business, intercultural communications, international trade and finance, global arts, and international law. Common languages to study are Arabic, French, German, Italian, Japanese, Mandarin, Russian, and Spanish.

Students majoring in international studies earn a BA degree. The major is useful for careers in the arts, business, engineering, government, health, law, media, and the nonprofit sector, among other fields.

Undergraduate Program

Major

The major in international studies requires a minimum of 33 credit hours, chosen from approved topical and area studies courses, plus satisfaction of a language competency requirement. Each student will prepare a program of study that includes course selections meeting the seven requirements below. Normally, no more than two courses taken for international studies credit may count simultaneously toward a minor or another major. Courses taken to satisfy the language competency requirement are exempted from this rule, and several international studies courses contribute to the completion of general education requirements.

Requirements for the Major

1. Multidisciplinary Foundations (required courses; 12 hours). These courses provide an introduction to understandings of society and culture, principles of economics, change over time, and interactions among countries, while exposing students to a variety of world societies and issues. International studies majors are encouraged to complete the multidisciplinary foundations courses before embarking on a study abroad program. These courses are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTH 102</td>
<td>Being Human: An Introduction to Social and Cultural Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>ECON 103</td>
<td>Principles of Macroeconomics (*)</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 113</td>
<td>Introduction to Modern World History</td>
<td>3</td>
</tr>
<tr>
<td>POSC 172</td>
<td>Introduction to International Relations</td>
<td>3</td>
</tr>
</tbody>
</table>

* Students who matriculated prior to Fall 2014 can use ECON 102 Principles of Microeconomics, rather than ECON 103 Principles of Macroeconomics, for the economics course, in accordance with the previous major requirements.

2. Area Focus (6 hours). Two courses that concentrate on a single region of the world. Such courses are offered in many departments and programs. In order to count toward the area focus, courses from the Department of Modern Languages and Literatures must include content other than exclusively language learning, such as the study of literature or cinema. Area foci include Africa, Asia, Europe, Latin America, and the Middle East.

3. Topical Focus (6 hours): A related pair of courses that examine a transnational topic. Topical foci include, but are not limited to, international security and diplomacy, global environment, international trade and finance, global health, international development, and global arts.

4. Elective Area or Topical Courses (6 hours): Two additional courses toward the area focus or topical focus.

5. Students must include courses from at least two different departments or programs among their six area focus, topical focus, and elective courses. (This is highly recommended, but not required, for students who matriculated prior to Fall 2014.) These courses should be selected in consultation with the international studies director.

6. Senior Project (required course, 3 hours): The senior project offers students the opportunity to demonstrate their understanding of the complexity and dynamics of the human world as a result of majoring in international studies. Students who matriculated Fall 2014 or later complete INTL 399 International Studies Colloquium if it is offered their senior fall. Otherwise, those students must complete INTL 398 International Studies Senior Research Project. Students who matriculated before Fall 2014 must complete INTL 398.

INTL 398 International Studies Senior Research Project: Students work individually with a faculty project advisor to research and write a major paper, typically in their senior year. Students should identify their faculty project advisors and topics no later than the semester before they intend to complete INTL 398. Students must complete a prospectus no later than the second week of the semester. Upon request to the international studies director, who seeks approval from the director of SAGES, this course can meet the requirements of a SAGES capstone.

INTL 399 International Studies Colloquium: Students analyze topics relevant to the foreign geographic area and broad theme they have chosen for their major foci. To do so, they draw on their international experience, knowledge acquired through a foreign language, and prior coursework for the major. Students share their conclusions in the seminar itself and in a public presentation. This course meets the requirements of a SAGES capstone.

7. Language Competency (0 to 16 credit hours): In addition to the 33 credit hours of international studies course work, students must demonstrate competency in a language other than their native language. This may be done by:

1. completing a language course at the 300 level or above
2. completing four semesters in a single language
3. demonstrating to the Department of Modern Languages and Literatures a non-native language competency equivalent to that attained by completing a 300-level or above course
Honors: Honors are awarded to students who meet three requirements: an exceptional senior project (grade of A), a 3.3 overall GPA, and a 3.7 GPA in international studies courses (area focus, topical focus, and electives).

There is no minor in international studies. International studies can be a secondary major.

**Faculty**
Kelly McMann, PhD
(University of Michigan)
Associate Professor, Department of Political Science; Director, International Studies Program

**Courses**

**INTL 396. International Independent Study. 1 - 3 Units.**
Study of a topic within the scope of international studies. The student must complete a prospectus form, approved and signed by the supervising faculty member, no later than the second week of classes. The prospectus must outline the goals of the project and the research methodology to be used and is part of the basis for grading. Open to juniors and seniors majoring in international studies.

**INTL 398. International Studies Senior Research Project. 3 Units.**
Individual work with a faculty tutor leading to the writing of a major research paper. Open only to seniors majoring in international studies.

**INTL 399. International Studies Colloquium. 3 Units.**
This course offers seniors the opportunity to demonstrate their understanding of the complexity and dynamics of the human world as a result of majoring in International Studies. Students analyze topics relevant to the foreign geographic areas and broad themes they have chosen for their major foci. To do so, they draw on their international experiences, knowledge acquired through foreign languages, and prior coursework for the major. Students share their conclusions in the seminar itself and in a public presentation. This course meets the requirements of a SAGES capstone.

**Japanese Studies Program**

103 Guilford House
www.case.edu/artsci/dmll/japanese.htm
Phone: 216-368-6188; Fax: 216-368-2216
Takao Hagiwara, Program Director
takao.hagiwara@case.edu

Today’s students find themselves in a world of increasingly multietnic, multi-religious, multicultural contexts. Through a long history of receiving, reworking, and incorporating influences from nearby cultural centers on the Asian mainland and surrounding Pacific islands and from the world beyond, including Europe and the Americas, Japan has developed a tradition of multiculturalism—a tradition that is best understood through interdisciplinary study. Following this thread, the Japanese Studies Program seeks to foster the student’s global and interdisciplinary perspectives, while at the same time maintaining a flexibility that allows individuals to pursue their own areas of interest. To further foster the students’ linguistic and cultural development, the Japanese Studies Program strongly encourages study abroad in Japan for a year, a semester, or a summer.

Students may pursue a major or a minor in Japanese studies. The program offers a variety of courses to fulfill the requirements, ranging from five levels of the Japanese language to courses about Japanese cinema, literature, and pop culture. Besides these core courses, we encourage the student to take related courses in such interdisciplinary areas as Asian art, cinema, comparative literature of Japan and the West, Japanese religion and history, and international business. Taking advantage of the varied resources of the university and University Circle institutions, the Japanese Studies Program makes the study of Japanese culture an integral part of the student’s undergraduate education. Furthermore, the Japanese Studies Program provides an excellent foundation for graduate or professional school or for careers in international business and finance, careers involving technological or medical exchange, and careers in law, journalism, foreign service, or the arts.

**Undergraduate Program**

**Major**

The BA major in Japanese studies requires a minimum of 35 credit hours. For students beginning the major at the 200 level, the course requirements are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>JAPN 201</td>
<td>Intermediate Japanese I</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 202</td>
<td>Intermediate Japanese II</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 301</td>
<td>Advanced Japanese I</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 302</td>
<td>Advanced Japanese II</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 350</td>
<td>Contemporary Japanese Texts I</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 351</td>
<td>Contemporary Japanese Texts II</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 397</td>
<td>Senior Thesis I</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 398</td>
<td>Senior Thesis II</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 450/451</td>
<td>Japanese in Cultural Context I</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 450/451</td>
<td>Japanese in Cultural Context II</td>
<td>4</td>
</tr>
</tbody>
</table>

Four Asian studies, world literature, or other related courses. ***

Total Units: 40

* JAPN 450/451, if not taken as replacement(s) for JAPN 350/351, can be counted toward the four Asian studies, world literature, or other related courses.

** This course requires a substantial research paper in Japanese or English. Students are required to identify their faculty advisors and the topic of their paper by the end of the junior year. Exceptional papers may be considered for honors.

*** “Other related courses” may include courses in Japanese literature, film, theater, art history, anthropology, philosophy, religion, sociology, political science, or history. Permission of Japanese Studies advisor required.

Students beginning the major at the 300 level do not take JAPN 201 Intermediate Japanese I and JAPN 202 Intermediate Japanese II, but do take one “directed reading” in Japanese in an area related to their major research. All other requirements for the BA are the same.

Courses in other disciplines also form an important component of the Japanese Studies Program. They provide an international, as well as interdisciplinary, perspective on Japanese culture. A faculty advisor supervises each student’s selection of these courses.

In addition to the courses required for the major, the following courses are offered in the Japanese Studies Program:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAPN/WLIT 225</td>
<td>Japanese Popular Culture</td>
<td>3</td>
</tr>
</tbody>
</table>
Minor

For students beginning Japanese at the introductory level, the course requirements for the minor are as follows:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAPN 101</td>
<td>Elementary Japanese I</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 102</td>
<td>Elementary Japanese II</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 201</td>
<td>Intermediate Japanese I</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 202</td>
<td>Intermediate Japanese II</td>
<td>4</td>
</tr>
<tr>
<td>JAPN 255</td>
<td>Modern Japanese Literature in Translation</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 309</td>
<td>Independent Study</td>
<td>1-3</td>
</tr>
<tr>
<td>JAPN 245</td>
<td>Japanese Women Writers</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 355</td>
<td>Modern Japanese Novels and the West</td>
<td>3</td>
</tr>
<tr>
<td>JAPN 399</td>
<td>Independent Study</td>
<td>1-3</td>
</tr>
</tbody>
</table>

For students beginning Japanese at the 200 level or above, the requirements for the minor are five courses at the 200 or above, through JAPN 450/451, approved by a program director.

Program Faculty

Takao Hagiwara, PhD  
(University of British Columbia)  
Associate Professor, Department of Modern Languages and Literatures;  
Director, Japanese Studies Program

Margaret M. Fitzgerald, MA  
(Ohio State University)  
Full-time Lecturer, Department of Modern Languages and Literatures

Yoshiko Kishi, MA  
(New York University)  
Full-time Lecturer, Department of Modern Languages and Literatures

Yuki Togawa, MA  
(Carnegie Mellon University)  
Full-time Lecturer, Department of Modern Languages and Literatures

Program Advisory Committee

William E. Deal, PhD  
(Harvard University)  
Severance Professor in the History of Religion, Department of Religious Studies; Chair, Department of Cognitive Science

Courses

JAPN 101. Elementary Japanese I. 4 Units.
Introduction to understanding, speaking, reading, and writing Japanese. Students learn to read and write hiragana and katakana syllabaries and 50 kanji characters. Students are expected to achieve control of the sound system and basic structure of the language. Emphasizes aural comprehension and speaking.

JAPN 102. Elementary Japanese II. 4 Units.

JAPN 201. Intermediate Japanese I. 4 Units.
Further study of fundamental structures of Japanese. Students improve aural comprehension, speaking, reading, and writing abilities and learn approximately 100 new characters. Recommended preparation: JAPN 102 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 202. Intermediate Japanese II. 4 Units.
Continuation of JAPN 201. Students learn an additional 100 kanji characters. With the completion of JAPN 201 - 202, students should have control of the fundamentals of modern Japanese and a firm foundation in the writing system. Recommended preparation: JAPN 201 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 225. Japanese Popular Culture. 3 Units.
This course highlights salient aspects of modern Japanese popular culture as expressed in animation, comics and literature. The works examined include films by Hayao Miyazaki, writings by Kenji Miyazawa, Haruki Murakami and Banana Yoshimoto, among others. The course introduces students to essential aspects of modern Japanese popular culture and sensibility. Offered as JAPN 225 and WLIT 225. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 245. Classical Japanese Literature in Translation. 3 Units.
Readings, in English translation, of classical Japanese poetry, essays, narratives, and drama to illustrate essential aspects of Japanese culture and sensibility before the Meiji Restoration (1868). Lectures explore the sociohistorical contexts and the character of major literary genres; discussions focus on interpreting the central images of human value within each period. Japanese sensibilities compared to and contrasted with those of Western and other cultures. Offered as JAPN 245 and WLIT 245. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 255. Modern Japanese Literature in Translation. 3 Units.
Focus on the major genres of modern Japanese literature, including poetry, short story, and novel (shosetsu). No knowledge of Japanese language or history is assumed. Lectures, readings, and discussions are in English. Films and slides complement course readings. Offered as JAPN 255 and WLIT 255. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 301. Advanced Japanese I. 4 Units.
Emphasizes conversational proficiency and reading. Students must use the course material offered by the Online Language Learning Center in addition to class meetings. Recommended preparation: JAPN 202 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.
JAPN 302. Advanced Japanese II. 4 Units.
Continuation of JAPN 301; emphasizes conversational proficiency and reading. Japanese life and culture introduced through supplemental materials and activities. Students must use the course material offered by the Online Language Learning Center in addition to class meetings. Recommended preparation: JAPN 301 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 345. Japanese Women Writers. 3 Units.
Contributions of women writers to the literature of pre-modern and modern Japan; investigations of how their works exemplify and diverge from "mainstream" literary practices. Emphasis on the social and cultural contexts of the texts. Offered as JAPN 345 and WLIT 345. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 350. Contemporary Japanese Texts I. 3 Units.
The primary aim of this course is to develop communication skills in Japanese based on those that the students have acquired in JAPN 302 or equivalent. The students will read and discuss various texts such as daily conversations, essays, and news scripts with the assistance of vocabulary and kanji (Chinese character) lists and formal grammar explanations. Attention also will be given to enhancing the students' writing and aural/oral proficiencies through regularly assigned homework, presentations, tape listening, video viewing, and classroom discussion. Recommended preparation: JAPN 302 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 351. Contemporary Japanese Texts II. 3 Units.
This course is a continuation of JAPN 350 and its primary aim overlaps with that of JAPN 350: to develop more sophisticated communication skills in Japanese. Students will read and discuss various texts such as daily conversations, essays, and news scripts largely with the assistance of vocabulary and kanji (Chinese character) lists. Attention will be given to enhancing the students' writing and aural/oral proficiencies through regularly assigned homework, presentations, tape listening, video viewing, and classrooms discussion. Counts for CAS Global & Cultural Diversity Requirement. Prerequisite: JAPN 350 or consent of instructor.

JAPN 355. Modern Japanese Novels and the West. 3 Units.
This course will compare modern Japanese and Western novels, drama, and novels. Comparisons will focus on the themes of family, gender and alienation, which subsume a number of interrelated sub-themes such as marriage, home, human sexuality, amae (dependence), innocence, experience, death, God/gods, and nature (the ecosystem). Offered as JAPN 355 and WLIT 355. Counts as CAS Global & Cultural Diversity Requirement. Prerequisite: JAPN 350 or consent of instructor.

JAPN 396. Senior Capstone - Japanese. 3 Units.
The Senior Capstone in Japanese is an independent study project chosen in consultation with a capstone advisor. The capstone project should reflect both the student's interest within Japanese and the courses he or she has taken to fulfill the major. The project requires independent research using an approved bibliography and plan of action. In addition to written research, the student will also present the capstone project in a public forum that is agreed upon by the project advisor and the student. Counts as SAGES Senior Capstone. Prerequisite: Senior status required. Major in Japanese required.

JAPN 397. Senior Thesis I. 3 Units.
Intensive study of a literary, linguistic, or cultural topic with a faculty member, leading to the writing of a research paper in English or Japanese. Limited to senior majors. Permit required.

JAPN 398. Senior Thesis II. 3 Units.
Continuation of JAPN 397. Limited to senior majors. Prerequisite: JAPN 397.

JAPN 399. Independent Study. 1 - 3 Units.
Directed study for students who have progressed beyond available course offerings.

JAPN 450. Japanese in Cultural Context I. 3 Units.
The primary aim of this graduate course is to develop sophisticated communication skills (listening, speaking, reading, and writing) in Japanese. The students will read and discuss various texts in the original, such as essays, news scripts, and literary works. Classroom instruction and discussion will be conducted in Japanese. The students also will be required to write a research paper of 4000-6000 letters/characters (10-15 genkoyoshi pages) in Japanese on a topic related to Japan and the student's specialty. Recommended preparation: JAPN 351 or equivalent.

JAPN 451. Japanese in Cultural Context II. 3 Units.
This course is a continuation of JAPN 450 and it aims at a further development of sophisticated communication skills (listening, speaking, reading, and writing) in Japanese. The students will read and discuss various texts in the original, such as essays, news scripts, and literary works both classical and modern. Classroom instruction and discussion will be conducted in Japanese. The students also will be required to write a research paper of 6000-8000 letters/characters (15-20 genkoyoshi pages) in Japanese on a topic related to Japan and the student's specialty. Recommended preparation: JAPN 450 or equivalent.

Judaic Studies Program

The Judaic Studies Program offers an interdisciplinary approach to the study of the history, religion, social experience, and culture of the Jewish people. By bringing a variety of fields and disciplines to bear on its subject, the program intends to convey to students the complex interaction of forces that create and express Jewish ethnic and religious identity. Students completing the program will have a broad knowledge of the field along with the tools necessary for continued study of Jewish civilization in all its manifestations.

Undergraduate Program

Minor
The minor consists of a minimum of five or six courses, according to the following scheme, to be chosen in consultation with the program director.

Required Courses:
A. Introduction to Judaic Studies 3
JDST 101    Jews and Judaism 3

B. Nine additional credit hours of courses that have a JDST cross-listing. Alternatively, students may take six credit hours of JDST courses plus three credit hours from one course on the following list:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 365E</td>
<td>The Immigrant Experience</td>
</tr>
<tr>
<td>HBRW 201</td>
<td>Intermediate Modern Hebrew I</td>
</tr>
<tr>
<td>HBRW 202</td>
<td>Intermediate Modern Hebrew II</td>
</tr>
<tr>
<td>HBRW 301</td>
<td>Advanced Modern Hebrew I</td>
</tr>
<tr>
<td>HBRW 302</td>
<td>Advanced Modern Hebrew II</td>
</tr>
<tr>
<td>HBRW 399</td>
<td>Independent Studies</td>
</tr>
<tr>
<td>HSTY 257</td>
<td>Immigrants in America</td>
</tr>
</tbody>
</table>
POS C 379  Introduction to Middle East Politics  8
C. Two semesters of Hebrew (HBRW 101 and HBRW 102). Students who place out of the 100-level HBRW courses must take an additional course from B as specified above.

Total Units  23

Program Faculty

Jay Geller, PhD
Samuel Rosenthal Professor of Judaic Studies; Associate Professor, Department of History; Director, Judaic Studies Program

Judith Neulander, PhD
Full-time Lecturer, Department of Religious Studies

Courses

JDST 101. Jews and Judaism. 3 Units.
This course provides an introduction to Jewish religion, culture, history, and life. It does not presuppose any previous study of Judaism or experience with Judaism, and it prepares students for additional coursework in Judaic studies, Jewish history, or religious studies with an emphasis on Judaism. Required for the minor in Judaic Studies. Offered as JDST 101 and RLGN 213. Counts for CAS Global & Cultural Diversity Requirement.

JDST 173. Introducing Judaism. 3 Units.
This "topics" course offers an introduction to the academic study of Judaism. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and basic religious literacy in Jewish religious tradition, exploring forms of it in a diversity of cultural contexts around the world. Section topics could include, but are not limited to: Festivals and Holy Days, Women and Gender, Jewish Ethics. Students may repeat the course for credit (up to 6 credits), provided that the two sections are different. Offered as RLGN 173 and JDST 173. Counts for CAS Global & Cultural Diversity Requirement.

JDST 208. Introduction to Western Religions. 3 Units.
Basic introduction to the three great monotheistic religions of the Western World: Christianity, Judaism, and Islam. All three of these religious traditions trace their roots to the faith of biblical Israel as revealed by a series of prophets including Noah, Abraham, and Moses. Each absorbed the philosophy and science of the Greco-Roman world and went on both to influence and struggle with each other. Many of the religious problems of the contemporary world, from Afghanistan to the Middle East to Yugoslavia, can be traced to tension within and between these religious groups. Offered as RLGN 208 and JDST 208. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

JDST 211. Great Books of Western Religion. 3 Units.
Students will engage with the major writings that have shaped Western religious traditions (Christianity, Judaism, Islam) from their earliest expressions until the present day. Readings include the foundational Scriptures (Hebrew Bible, New Testament, Quran) of each tradition, religious poetry and other writings from the Middle Ages, and modern writers on spirituality and religiousness within each of these traditions. The course will be conducted as a seminar, in which students will read the selected original texts and will discuss their religious and spiritual meaning and significance in class. Each student will also prepare a final project based on the assigned authors or readings. Offered as RLGN 211 and JDST 211.

JDST 218. Jews in Early Modern Europe. 3 Units.
This course surveys the history of Jews in Europe and the wider world from the Spanish expulsion through the French Revolution. Tracking peregrinations out of the Iberian Peninsula to the British Isles, France, Holland, Italy, Germany, Poland-Lithuania, the Ottoman Empire, and the American colonies, it examines the diverse ways Jews organized their communities, interacted with their non-Jewish neighbors, and negotiated their social, economic, and legal status within different states and empires. What role did Jews play and what symbolic place did they occupy during a period of European expansion, technological innovation, artistic experimentation, and religious and political turmoil? What internal and external dynamics affected Jewish experiences in the sixteenth, seventeenth, and eighteenth centuries? Through a selection of inquisitorial transcripts, government records, memoirs, and historical literature, we will explore topics such as persecution, conversion, messianism, toleration, emancipation, and assimilation. Offered as HSTY 218, JDST 218, and ETHS 218. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

JDST 220. Jewish Traditional Art and Architecture. 3 Units.
Tradition and transformation in Jewish artistic expression over time and across space. Course will begin with biblical period and continue down to the present day in Israel and America. Examination of how concepts such as "Jewish" and "art" undergo change within the Jewish community over this period. Offered as ARTH 220 and JDST 220. Counts for CAS Global & Cultural Diversity Requirement.

JDST 223. Religious Roots of Conflict in the Middle East. 3 Units.
The course is about the rhetoric and symbols used by various voices in the Middle East in the ongoing debate about the future shape of the region. For historical and cultural reasons, much of the discourse draws on religious symbolism, especially (although not exclusively) Islamic, Jewish and Christian. Because of the long and complex history of the region and the religious communities in it, virtually every act and every place is fraught with meaning. The course examines the diverse symbols and rhetorical strategies used by the various sides in the conflict and how they are understood both by various audiences within each community and among the different communities. Offered as JDST 223 and RLGN 223. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.
JDST 228. The Jewish Image in Popular Film. 3 Units.
Explores film as social practice for its makers and its audience from the silent era through Hollywood's Golden Age, to the technological dazzle of the present day. Notes views of the Jews as stereotypical "Racial Other" not only capable of Jewish self-representation, but also capable of representing any group widely believed to be non-white, non-Christian or otherwise "alien." By studying select films in historical context, the course will trace changes in this stereotype. By the end of the semester, students will understand how film is shaped by, and how it actively shapes, our construction of American Selves vs. Ethnic Others. Counts for CAS Global & Cultural Diversity Requirement.

JDST 233. Introduction to Jewish Folklore. 3 Units.
Exploration of a variety of genres, research methods and interpretations of Jewish folklore, from antiquity to the present. Emphasis on how Jewish folk traditions and culture give us access to the spirit and mentality of the many different generations of the Jewish ethnic group, illuminating its past and informing the direction of its future development. Offered as ANTH 233, RLGN 233, and JDST 233. Counts for CAS Global & Cultural Diversity Requirement.

JDST 254. The Holocaust. 3 Units.
This class seeks to answer fundamental questions about the Holocaust: the German-led organized mass murder of nearly six million Jews and millions of other ethnic and religious minorities. It will investigate the origins and development of racism in modern European society, the manifestations of that racism, and responses to persecution. An additional focus of the course will be comparisons between different groups, different countries, and different phases during the Nazi era. Offered as HSTY 254, RLGN 254, ETHS 254, and JDST 254. Counts for CAS Global & Cultural Diversity Requirement.

JDST 268. Women in the Bible: Ethnographic Approaches to Rite and Ritual, Story, Song, and Art. 3 Units.
Examination of women in Jewish and Christian Biblical texts, along with their Jewish, Christian (and occasionally Muslim) interpretations. Discussion of how these traditions have shaped images of, and attitudes toward, women in western civilization. Offered as RLGN 268, WGST 268, and JDST 268.

JDST 280. Religion and Politics in the Middle East. 3 Units.
An in-depth look at the relationship between politics and religion in the Middle East. Students will spend the first week on the CWRU campus and the last three weeks in Israel, where time will be divided between classroom teaching, guest lectures, and "field trips" to important sites. Students will have the opportunity to interact directly with members of the region's diverse religious groups within the political, social, and cultural contexts in which they live. A final research paper will be required. Knowledge of Hebrew is not necessary. Offered as JDST 280 and RLGN 280.

JDST 314. Mythologies of the Afterlife. 3 Units.
This course provides a multidisciplinary approach to the idea of an afterlife, and its manifestation in diverse cultures. We will examine the way varying views of the afterlife influence religion, popular culture and palliative care, and how human creativity has shaped the heavens, hells, hauntings and holidays of diverse populations over time and across space. Students will come to see the afterlife as an integral part of human history and experience, not only because it helps people die with better hope, but because it helps them to live more richly. Offered as RLGN 314 and JDST 314.

JDST 326. The Holocaust and the Arts. 3 Units.
This course explores artistic output during the Holocaust, as well as responses to the Holocaust in various forms, including music, art, architecture, film, and literature. Offered as MUHI 326, JDST 326, HSTY 326 and RLGN 326 Counts for CAS Global & Cultural Diversity Requirement.

JDST 341. Jewish Urban History. 3 Units.
This course examines the relationship between Jews and the modern urban environment. It seeks to answer questions such as: How did the modernization of cities affect Jews and Jewish communities? In what ways did Jews contribute to modern urban cultural and social forms? What is Jewish urban space, is it unique, and how is it remembered later on? Are there differences between the patterns in Europe, the Middle East, and the Americas? Offered as HSTY 341 and JDST 341. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

JDST 350. Jewish Ethics. 3 Units.
An exploration of Jewish moral and ethical discourse. The first half of the course will be devoted to studying the structure and content of classical Jewish ethics on issues including marriage, abortion, euthanasia, and social justice. Students will read and react to primary Jewish religious texts. The second half of the course will focus on various modern forms of Judaism and the diversity of moral rhetoric in the Jewish community today. Readings will include such modern thinkers as Martin Buber and Abraham Joshua Heschel. Offered as JDST 350, RLGN 350, and RLGN 450. Counts as SAGES Departmental Seminar.

JDST 371. Jews under Islam and Christianity. 3 Units.
This course examines the social and political status of Jews under Muslim and Christian rule since the Middle Ages. Themes include interfaith relations, Islamic and Christian beliefs regarding the Jews, Muslim and Christian regulation of Jewry, and the Jewish response. Offered as HSTY 371, JDST 371 and RLGN 371. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

JDST 389. History of Zionism. 3 Units.
This course seeks to elucidate the major strands of Zionism, their origins, how they have interacted, and their impact on contemporary Israeli society. These may include political Zionism, cultural Zionism, socialist (labor) Zionism, Revisionist Zionism, and religious Zionism. This course will also examine the differences in the appeal of Zionism to Jews in different places, such as Western Europe, Eastern Europe and the United States. Offered as HSTY 389 and JDST 389. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

JDST 392. Independent Study. 1 - 3 Units.
Up to three semester hours of independent study may be taken in a single semester.

Department of Mathematics, Applied Mathematics, and Statistics

231 Yost Hall
http://mathstats.case.edu/
Phone: 216.368.2880; Fax: 216.368.5163
Mary Ann Horn, Chair

The Department of Mathematics, Applied Mathematics, and Statistics at Case Western Reserve University is an active center for mathematical and statistical research. Faculty members conduct research in algebra,
analysis, applied mathematics, convexity, dynamical systems, geometry, imaging, inverse problems, life sciences applications, mathematical biology, modeling, numerical analysis, probability, scientific computing, statistics, stochastic systems, and other areas.

The department offers a variety of programs leading to both undergraduate and graduate degrees in traditional and applied mathematics and statistics. Undergraduate degrees are Bachelor of Arts or Bachelor of Science in mathematics, Bachelor of Science in applied mathematics, Bachelor of Arts or Bachelor of Science in statistics. Graduate degrees are Master of Science and Doctor of Philosophy.

Integrated BS/MS programs allow a student to earn a Bachelor of Science in either mathematics or applied mathematics and a Master of Science in this department or another department in five years; there is a similar integrated bachelor’s/master’s degree program in statistics. The department, in cooperation with the college’s Teacher Licensure Program, offers a course of study for individuals interested in pre-college teaching. Together with the Department of Physics, it offers a specialized joint Bachelor of Science in Mathematics and Physics.

Mathematics plays a central role in the physical, biological, economic, and social sciences. Because of this, individuals with degrees in mathematics enjoy excellent employment prospects and career opportunities. A bachelor’s degree in mathematics or applied mathematics provides a strong background for graduate school in many areas (including computer science, medicine, and law, in addition to mathematics and science) or for a position in the private sector. A master’s degree in mathematics or applied mathematics, or an undergraduate degree in applied mathematics combined with a master’s in a different area, is an excellent basis for private-sector employment in a technical field. A PhD degree is usually necessary for college teaching and research.

Statistics links mathematics to other disciplines in order to understand uncertainty and probability, both in the abstract and in the context of actual applications to science, medicine, actuarial science, social science, management science, business, engineering, and contemporary life. As technology brings advances, the statistical theory and methodology required to do them justice becomes more challenging: higher-dimensional, dynamic, or computer-intensive. The field of statistics is rapidly expanding to meet the three facets of these challenges: the underlying mathematical theory, data analysis and modeling methodology, and interdisciplinary collaborations and new fields of application.

Students in the department, both undergraduate and graduate, have opportunities to interact personally with faculty and other students, participate in research, and engage in other activities. In addition, undergraduates can obtain teaching experience through the department’s supplemental instruction program.

**Undergraduate Programs**

**Majors**

A Bachelor of Arts in mathematics, a Bachelor of Science in mathematics, a Bachelor of Science in applied mathematics, a Bachelor of Science in mathematics and physics, a Bachelor of Arts in statistics, and a Bachelor of Science in statistics are available to students at Case Western Reserve University. All undergraduate degrees in the department are based on a four-course sequence in calculus and differential equations and have a computational component. The mathematics degrees all require a further mathematics core in analysis and algebra. The statistics degrees all require a further statistics core. Each of these cores consists of four courses. There are additional technical requirements particular to each degree.

**Bachelor of Arts in Mathematics**

The BA degree in mathematics requires at least 38 hours of mathematics courses, including:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 124</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 227</td>
<td>Calculus III</td>
<td></td>
</tr>
<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 228</td>
<td>Differential Equations</td>
<td></td>
</tr>
<tr>
<td>MATH 307</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 308</td>
<td>Introduction to Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 321</td>
<td>Fundamentals of Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 322</td>
<td>Fundamentals of Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 324</td>
<td>Introduction to Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 425</td>
<td>Complex Analysis I</td>
<td></td>
</tr>
</tbody>
</table>

Three approved technical electives * 9

**Total Units** 41

* No more than one can be from outside the department.
** Or other approved computer science course.

**Teacher Licensure**

The Department offers a special option for undergraduate students who wish to pursue a mathematics major and a career in teaching. The Adolescent to Young Adult (AYA) Teacher Licensure Program in Integrated Mathematics prepares CWRU students to receive an Ohio Teaching License for grades 7-12. Students declare a second major in education—which involves 34 hours in education and a practicum requirement—and complete a planned sequence of mathematics content courses within the context of a mathematics major. The program is designed to offer several unique features not found in other programs and to place students in mentored teaching situations throughout their teacher preparation career. This small, rigorous program is designed to capitalize on the strengths of the department, the CWRU Teacher Licensure Program, and the relationships the university has built with area schools.

The requirements of the program are:

(a) Completion of the BA program in mathematics, including the following as the three approved technical electives:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 150</td>
<td>Mathematics from a Mathematician's Perspective</td>
<td>3</td>
</tr>
<tr>
<td>MATH 304</td>
<td>Discrete Mathematics</td>
<td>3</td>
</tr>
</tbody>
</table>
(b) The completion of a second major in education. Students interested in this option should consult the description of the Teacher Licensure Program (p. 522) elsewhere in this bulletin or contact the director of teacher licensure.

**Bachelor of Science in Mathematics**

The BS degree in mathematics requires at least 50 hours of mathematics courses, including:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 124</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 227</td>
<td>Calculus III</td>
<td></td>
</tr>
<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 228</td>
<td>Differential Equations</td>
<td></td>
</tr>
<tr>
<td>MATH 307</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 308</td>
<td>Introduction to Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 321</td>
<td>Fundamentals of Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 322</td>
<td>Fundamentals of Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 324</td>
<td>Introduction to Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 425</td>
<td>Complex Analysis I</td>
<td></td>
</tr>
<tr>
<td>MATH 330</td>
<td>Introduction of Scientific Computing</td>
<td>3</td>
</tr>
</tbody>
</table>

Six approved technical electives * 18

The following three courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

One of the following sequences: 6

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 201 &amp; ASTR 202</td>
<td>The Sun and its Planets and Stars, Galaxies, and the Universe</td>
<td></td>
</tr>
<tr>
<td>CHEM 105 &amp; CHEM 106</td>
<td>Principles of Chemistry I and Principles of Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 111 &amp; ENGR 145</td>
<td>Principles of Chemistry for Engineers and Chemistry of Materials</td>
<td></td>
</tr>
<tr>
<td>EEPS 110 &amp; EEPS 115 &amp; EEPS 210</td>
<td>Physical Geology and Introduction to Oceanography and Earth History: Time, Tectonics, Climate, and Life</td>
<td></td>
</tr>
</tbody>
</table>

Total Units 67

* No more than 9 hours may be from outside the department.

**Bachelor of Science in Applied Mathematics**

A student in this degree program must design a program of study in consultation with his or her academic advisor. This program of study must explicitly list the mathematics electives and the professional core in the area of application.

Areas of research in applied mathematics well represented in the department include:

- Applied dynamical systems
- Applied probability and stochastic processes
- Imaging
- Life science
- Scientific computing

Study plans with emphasis on areas of application closely related to mathematics but centered in other departments will also be considered. Such areas might include engineering applications, biology, cognitive science, or economics.

The BS degree in applied mathematics requires at least 50 hours of course work in mathematics and related subjects, in addition to a professional core that is specific to the area of application of interest to the student, including:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 124</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 227</td>
<td>Calculus III</td>
<td></td>
</tr>
<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 228</td>
<td>Differential Equations</td>
<td></td>
</tr>
<tr>
<td>MATH 307</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 308</td>
<td>Introduction to Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 321</td>
<td>Fundamentals of Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 322</td>
<td>Fundamentals of Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 324</td>
<td>Introduction to Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 425</td>
<td>Complex Analysis I</td>
<td></td>
</tr>
<tr>
<td>MATH 330</td>
<td>Introduction of Scientific Computing</td>
<td>3</td>
</tr>
</tbody>
</table>

One of the following two courses: 3

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 324</td>
<td>Introduction to Complex Analysis</td>
<td></td>
</tr>
<tr>
<td>MATH 425</td>
<td>Complex Analysis I</td>
<td></td>
</tr>
</tbody>
</table>

Approved mathematics electives: 21

- Four courses specific to the concentration area of interest to the student (12 units)
- Three MATH courses at the 300 level or higher (9 units)

**Professional Core requirement**

12 approved credit hours specific to an area of application. This requirement is intended to promote scientific breadth and encourage application of mathematics to other fields.

**Non-mathematics requirements**

The following three courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

One of the following sequences: 6-8
Bachelor of Science in Mathematics and Physics

In contrast to the BS in applied mathematics or the BS in physics with a mathematical physics concentration, this degree provides a synergistic, coherent, and parallel education in mathematics and physics. To a close approximation, the challenging course work corresponds to combining the mathematics and physics cores, with the Physics Laboratory cluster replaced by a single, fourth-year laboratory semester. A student in this program may use either of two official advisors, one available from each department, who would also constitute a committee for the administration of the degree and the approval of curriculum petitions.

The BS degree in mathematics and physics requires a total of 126 credits, including:

A. Mathematics requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 224</td>
<td>Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 227</td>
<td>Calculus III</td>
<td>3</td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 228</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 307</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 330</td>
<td>Introduction to Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 321</td>
<td>Fundamentals of Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 322</td>
<td>Fundamentals of Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 324</td>
<td>Introduction to Complex Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Approved Mathematics electives</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

B. Physics requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 301</td>
<td>Classical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 313</td>
<td>Thermodynamics and Statistical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 331</td>
<td>Introduction to Quantum Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 481</td>
<td>Quantum Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 332</td>
<td>Introduction to Quantum Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>or PHYS 482</td>
<td>Quantum Mechanics II</td>
<td>3</td>
</tr>
</tbody>
</table>

One of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 315</td>
<td>Introduction to Solid State Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 316</td>
<td>Introduction to Nuclear and Particle Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 326</td>
<td>Physical Optics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 327</td>
<td>Laser Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 328</td>
<td>Cosmology and the Structure of the Universe</td>
<td>3</td>
</tr>
</tbody>
</table>

C. Senior project and seminar, one of two options:

C. (i) Mathematics option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 351</td>
<td>Senior Project for the Mathematics and Physics Program</td>
<td>3</td>
</tr>
<tr>
<td>SAGES departmental seminar in Mathematics</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

C. (ii) Physics option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 303</td>
<td>Advanced Laboratory Physics Seminar</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 351</td>
<td>Senior Physics Project</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 352</td>
<td>Senior Physics Project Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

D. Other science requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3-4</td>
</tr>
<tr>
<td>or CHEM 111</td>
<td>Principles of Chemistry for Engineers</td>
<td>3-4</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3-4</td>
</tr>
<tr>
<td>or ENGR 145</td>
<td>Chemistry of Materials</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 131</td>
<td>Elementary Computer Programming</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units 88-91

* If approved by the M&P committee, other science sequence courses may be substituted.

In addition to the major course work listed, there are requirements of 10 hours of SAGES First and University Seminars, 12 hours of CAS distribution requirements, and enough open electives to bring the total number of hours to at least 126.

First Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 310</td>
<td>Classical Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 313</td>
<td>Thermodynamics and Statistical Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>
Bachelor's Degrees in Statistics

Students in statistics begin with a foundation in mathematics. Then they add statistical theory, plus intensive modern data analysis and a concentration in a field of their choice. The goal is to develop an appreciation of each facet of the discipline and a mastery of technical skills. This prepares students to enter a growing profession with opportunities in the academic, governmental, actuarial, and industrial spheres.

For the undergraduate student looking toward graduate school, the course of study within these guidelines easily incorporates additional mathematics in preparation for graduate courses. A student interested in Actuarial Science should take STAT 317 and 318 among the 15 hours in statistical methodology, and should discuss with their advisor courses in operations research and numerical analysis which are fundamental to actuarial theory and computation.

BA in Statistics

The BA degree offers flexibility and the chance to pursue a wider range of interests than the BS degree allows. It also offers students the possibility of expanding the interdisciplinary aspect of the program by completing a second major. For example, students may combine statistics with computer science, biology (molecular, organismal, or ecological), psychology, economics, accounting, or management science.

The BA degree in statistics requires a minimum of 56 hours of approved course work, including 27 hours in statistics and the remainder in related disciplines and a substantive field of application. The specific requirements are as follows:
MATH 121  Calculus for Science and Engineering I  4
MATH 122  Calculus for Science and Engineering II  4
or MATH 124  Calculus II  4
MATH 223  Calculus for Science and Engineering III  3
or MATH 227  Calculus III  3
MATH 224  Elementary Differential Equations  3
or MATH 228  Differential Equations  3
MATH 201  Introduction to Linear Algebra for Applications  3

Two computation classes  6
  ENGR 131  Elementary Computer Programming  6
An additional higher-numbered course in computation from EECS or EPBI 414
STAT 325  Data Analysis and Linear Models  3
STAT 326  Multivariate Analysis and Data Mining  3
STAT 345  Theoretical Statistics I  3
STAT 346  Theoretical Statistics II  3
At least 15 hours of courses in statistical methodology. This may include STAT 243, STAT 244, any 300-level or higher STAT courses, or approved 300-level or higher courses in statistical methodology or probability taught in biostatistics, electrical engineering and computer science, economics, mathematics, operations research, systems engineering, etc. At least 6 hours must be in STAT.
Two approved courses (or more) numbered 300 or above in an approved discipline outside statistics.  6
A combined total of 12 hours (or more) in ASTR, BIOL, CHEM, or PHYS which may be counted toward a major in that field, including at least one of the following sequences:
  PHYS 121 & PHYS 122  General Physics I - Mechanics and General Physics II - Electricity and Magnetism
  CHEM 105 & CHEM 106 & CHEM 113  Principles of Chemistry I and Principles of Chemistry II and Principles of Chemistry Laboratory
Students are strongly encouraged to include advanced expository or technical writing courses in their programs.
Total Units  56
A student in this program has the option of a concentration in Actuarial Science, described below.

BS in Statistics

The BS degree in statistics requires a minimum of 68 hours of approved course work, including 27 hours in statistics and the remainder in related disciplines and a substantive field of application. In addition to the requirements for the BA, the BS degree includes a laboratory science requirement. For students seriously interested in basic science, a natural science is the logical choice as a focus for the application, and the BS degree is the logical choice of program. The specific requirements are as follows:

MATH 121  Calculus for Science and Engineering I  4
MATH 122  Calculus for Science and Engineering II  4
or MATH 124  Calculus II  4
MATH 223  Calculus for Science and Engineering III  3
or MATH 227  Calculus III  3
MATH 224  Elementary Differential Equations  3
or MATH 228  Differential Equations  3

STAT 317, 318, and at least six additional hours of approved STAT courses. A student finishing this concentration will have completed at least 30 hours in statistics. Students in this concentration should consult with their advisors before choosing these courses, and for information about additional non-required courses that might be useful for actuarial science.

BS in Actuarial Science

The BS degree in actuarial science requires a minimum of 68 hours of approved course work, including 27 hours in statistics and the remainder in related disciplines and a substantive field of application. In addition to the requirements for the BA, the BS degree includes a laboratory science requirement. For students seriously interested in basic science, a natural science is the logical choice as a focus for the application, and the BS degree is the logical choice of program. The specific requirements are as follows:

MATH 121  Calculus for Science and Engineering I  4
MATH 122  Calculus for Science and Engineering II  4
or MATH 124  Calculus II  4
MATH 223  Calculus for Science and Engineering III  3
or MATH 227  Calculus III  3
MATH 224  Elementary Differential Equations  3
or MATH 228  Differential Equations  3

STAT 317, 318, and at least six additional hours of approved STAT courses. A student finishing this concentration will have completed at least 30 hours in statistics. Students in this concentration should consult with their advisors before choosing these courses, and for information about additional non-required courses that might be useful for actuarial science.

Integrated BS/MS Program in Mathematics and/or Applied Mathematics

The integrated BS/MS program is intended for highly motivated candidates for the BS in mathematics and applied mathematics who wish to pursue an advanced degree. Application to the BS/MS program must be made after completion of 75 semester hours of course work and prior
to attaining senior status (completion of 90 semester hours). Generally, this means that a student will submit the application during his/her sixth semester of undergraduate course enrollment and will have no fewer than two semesters of remaining BS requirements to complete. Applicants should consult the dean of undergraduate studies.

A student admitted to the program may, in the senior year, take up to nine hours of graduate courses (400 level and above) that will count towards both BS and MS requirements. The courses to be doubled-counted must be specified at the time of application. Any undergraduate course work that is to be applied to the MS must be beyond that used to satisfy BS degree requirements and must conform to university, graduate school, and department rules. Students may petition to transfer graduate course work taken prior to application to the BS/MS program subject to the rules of the graduate school.

Students for whom the master’s project or thesis is a continuation and development of the senior project should register for (or the appropriate project course) during the senior year and are expected to complete all other courses for the BS before enrolling in further MS course work and thesis (continuing the senior project). Students for whom the master’s thesis or project is distinct from the senior project will be expected to complete the BS degree before taking further graduate courses for the master’s degree.

Integrated BS/MS in Applied Mathematics and Another Discipline

There is the possibility of an integrated five-year study plan leading to a BS in applied mathematics and an MS in the area of application. In order to complete the requirements for the BS/MS in five years, students must choose an area outside mathematics that integrates well with mathematics, such as computing/information science, operations research, systems engineering, control theory, biology, or cognitive science. The general academic requirements for Integrated BS/MS programs must be followed. (Since the graduate courses required for the MS degree are determined by the respective department, each student in the dual-degree program should have a secondary advisor in that department, starting no later than the junior year, and should consult with this advisor concerning requirements for the MS degree.)

Integrated Bachelors/MS in Statistics

The combined bachelor-master degrees in statistics require a minimum of 21 hours beyond the bachelor’s degree requirements. In total, 42 hours must be in statistics, including an MS thesis or MS research project, with the remainder (either 41 or 26 hours for BS or BA, respectively) in approved coursework in related disciplines and a field of application. In addition to the BS or BA requirements, a combined degree program must include:

1. STAT 455 and three semesters of STAT 491;
2. STAT 495;
3. MS research project (STAT 621) or MS Thesis (STAT 651);
4. At least 6 additional hours of courses in statistical theory and methodology (making a total of 21 hours including at least 4 STAT courses numbered 400 or higher) to be chosen from Statistics Department offerings numbered 300 and higher, or approved courses in statistical methodology or probability taught in biostatistics, computer science, economics, mathematics, operations research, systems engineering, etc. Students are strongly encouraged to include advanced expository or technical writing courses in their programs.

Minor in Mathematics

A minor in mathematics is available to all undergraduates. No more than two courses can be used to satisfy both minor requirements and the requirements of the student’s major field (meaning departmental degree requirements, including departmental technical electives and common course requirements of the student’s school).

The minor in mathematics requires 17 hours of mathematics courses, including:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
</tr>
<tr>
<td>or MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
</tr>
<tr>
<td>or MATH 124</td>
<td>Calculus II</td>
</tr>
<tr>
<td>or MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
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<tr>
<td>or MATH 227</td>
<td>Calculus III</td>
</tr>
<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
</tr>
<tr>
<td>or MATH 228</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>MATH 150</td>
<td>Mathematics from a Mathematician’s Perspective *</td>
</tr>
<tr>
<td>MATH 201</td>
<td>Introduction to Linear Algebra for Applications</td>
</tr>
<tr>
<td>or MATH 307</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>MATH 301</td>
<td>Undergraduate Reading Course</td>
</tr>
<tr>
<td>MATH 302</td>
<td>Departmental Seminar</td>
</tr>
<tr>
<td>MATH 303</td>
<td>Elementary Number Theory</td>
</tr>
<tr>
<td>MATH 304</td>
<td>Discrete Mathematics</td>
</tr>
<tr>
<td>MATH 308</td>
<td>Introduction to Abstract Algebra</td>
</tr>
<tr>
<td>MATH 321</td>
<td>Fundamentals of Analysis I</td>
</tr>
<tr>
<td>MATH 322</td>
<td>Fundamentals of Analysis II</td>
</tr>
<tr>
<td>MATH 324</td>
<td>Introduction to Complex Analysis</td>
</tr>
<tr>
<td>MATH 327</td>
<td>Convexity and Optimization</td>
</tr>
<tr>
<td>MATH 330</td>
<td>Introduction of Scientific Computing</td>
</tr>
<tr>
<td>MATH 333</td>
<td>Mathematics and Brain</td>
</tr>
<tr>
<td>MATH 338</td>
<td>Introduction to Dynamical Systems</td>
</tr>
<tr>
<td>MATH 343</td>
<td>Theoretical Computer Science</td>
</tr>
<tr>
<td>MATH 363</td>
<td>Knot Theory</td>
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<tr>
<td>MATH 380</td>
<td>Introduction to Probability</td>
</tr>
<tr>
<td>Or any 400-level MATH course</td>
<td></td>
</tr>
</tbody>
</table>

* To count toward a minor in mathematics, MATH 150 Mathematics from a Mathematician’s Perspective must be taken in the first or second year.
Minor in Statistics
A minor in statistics requires a minimum of 15 hours of approved course work. The minor must satisfy the requirements below and must include a minimum of 9 credits in STAT courses.

One of the following sequences:

<table>
<thead>
<tr>
<th>STAT 243 &amp; STAT 244</th>
<th>Statistical Theory with Application I and Statistical Theory with Application II</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 345 &amp; STAT 346</td>
<td>Theoretical Statistics I and Theoretical Statistics II</td>
</tr>
<tr>
<td>Or other approved sequence</td>
<td></td>
</tr>
</tbody>
</table>

One of the following:

<table>
<thead>
<tr>
<th>STAT 312</th>
<th>Basic Statistics for Engineering and Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
</tr>
<tr>
<td>STAT 332</td>
<td>Statistics for Signal Processing</td>
</tr>
<tr>
<td>STAT 333</td>
<td>Uncertainty in Engineering and Science</td>
</tr>
<tr>
<td>STAT 325</td>
<td>Data Analysis and Linear Models</td>
</tr>
</tbody>
</table>

Two approved elective courses numbered 300 or above. 6

Total Units 15

Graduate Programs
The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees. At the master's level, students may pursue degrees in mathematics, applied mathematics, or statistics. At the doctoral level, students may pursue degrees in mathematics or applied mathematics.

A student must satisfy all of the general requirements of the graduate school as well as the more specific requirements of the department to earn either a master's or doctoral degree. Each graduate student is assigned a faculty advisory committee during the first year of study. The committee's primary responsibility is to help the student plan an appropriate and sufficiently broad program of course work and study that will satisfy both the degree requirements and the special interests of the student. With the aid of the advisory committee, each student must present a study plan indicating how he or she intends to satisfy the requirements for a graduate degree.

The main requirements are as follows.

Master of Science in Mathematics
A minimum of 30 credit hours of approved course work, at least 18 of which must be at the 400 level or higher, is required for the MS degree in mathematics. The 30 credit hours required for graduation must include 6 credits each from two of the following three basic areas:

Abstract Algebra
- MATH 401 Abstract Algebra I
- MATH 402 Abstract Algebra II

Analysis
- MATH 423 Introduction to Real Analysis I
- MATH 424 Introduction to Real Analysis II
- MATH 425 Complex Analysis I

Geometry and topology
- MATH 461 Introduction to Topology

The student must pass a comprehensive oral examination on three areas, two of which must be selected from the basic ones listed above (although no particular courses are specified). The third area for the examination may be any approved subject.

A student in the MS program in mathematics may substitute the comprehensive exam examination requirement with an expository or original thesis, which will count as 6 credit hours of course work. The thesis will be defended in the course of an oral examination, during which the student will be questioned about the thesis and related topics. These two variants correspond to the graduate school's Plan A and Plan B.

Master of Science in Applied Mathematics
The department offers specialized programs in applied mathematics. For each of the programs, there is a minimum requirement of 27 credit hours of course work, at least 18 of which must be at the 400 level or higher. Students in the program must complete course work requirements in each of the following groups:

- At least 15 hours offered by the Department of Mathematics, Applied Mathematics, and Statistics
- At least 6 hours of courses offered outside the Department of Mathematics, Applied Mathematics, and Statistics
- 6 hours of thesis work (see below) or successful completion of a comprehensive exam

Given the great diversity of topics used in applications, there cannot be a large common core of requirements for the MS in applied mathematics. Still, all students pursuing this degree are strongly advised to take MATH 431 Introduction to Numerical Analysis I and MATH 441 Mathematical Modeling. In addition, to add breadth to the student's education, the set of courses taken within the department must include three credit hours of approved course work in at least three of the following seven breadth areas. (The list includes suitable courses for each area. Please note that a course may be used to satisfy only one breadth area requirement.)

Applied Mathematics Breadth Areas

Analysis and Linear Analysis:
- MATH 471 Advanced Engineering Mathematics
- MATH 423 Introduction to Real Analysis I
- MATH 405 Advanced Matrix Analysis

Probability and its Applications:
- MATH 439 Integrated Numerical and Statistical Computations
- MATH 491 Probability I

Numerical Analysis and Scientific Computing:
- MATH 431 Introduction to Numerical Analysis I
- MATH 432 Numerical Differential Equations
- MATH 433 Numerical Solutions of Nonlinear Systems and Optimization

Differential Equations:
- MATH 435 Ordinary Differential Equations
In addition to the course work, all PhD students in both tracks must complete the following specific requirements:

**Qualifying Exams**

Each student will be required to take two written qualifying exams. The exams will be in analysis and algebra for the mathematics track, and in numerical analysis and modeling for the applied mathematics track. Syllabi for the exams are available to students. Exams will be offered twice a year, usually in January and May. Students may attempt each exam up to two times. Under normal circumstances, students are expected to have passed both exams by the end of their fifth semester.

**Area Exam**

Each student will be required to pass an oral examination showing knowledge of the background and literature in the chosen area of specialization. The exam will be administered by the student’s advising committee, chaired by the principal advisor. The exam should normally take place within one year after final passage of the qualifying examinations and at least one year before the defense takes place. A student may retake the required exam once.

A written syllabus, with a list of the papers for which the student will be responsible, should be prepared and agreed upon by the student and advising committee at least two months before the exam takes place, at which time a specific date and time for the exam should be decided. Both the syllabus and the scheduled date of the exam should then be reported to the graduate committee. Once the syllabus and exam date have been reported to the graduate committee, the student will advance to PhD candidacy.

**Yearly Progress Reports**

After passing the area exam, students will present yearly progress reports to their advising committees, usually in April. These reports will consist of both a written summary of progress and an oral presentation delivered to the advising committee.

**Dissertation, Expository Talk, and Defense**

Students are required to produce a written dissertation and present an oral defense. The dissertation is expected to constitute an original contribution to mathematical knowledge. It must be provided to the defense committee (the composition of which is discussed below) at least 10 days prior to the defense. Students are required to give a colloquium-level presentation of their thesis work, open to all students and faculty, followed by an oral defense of the thesis work to the defense committee. The committee consists of at least four faculty members, including the student’s principal advisor and at least one outside faculty member.

Deadlines for the thesis defense and approval of the dissertation are determined by the School of Graduate Studies. It is the student’s responsibility to be aware of deadlines and make sure they are met.

**Requirements specific to the different tracks**

**Mathematics Track**

A student in the traditional mathematics program must demonstrate knowledge of the basic concepts and techniques of algebra, analysis (real and complex), and topology. This includes taking all courses in the three basic areas, and successfully completing qualifying examinations in algebra and analysis.
Qualifying Examination
A doctoral student in the mathematics track must take written examinations on abstract algebra and real analysis, as well as an oral examination in his or her chosen area of specialization. Subjects include complex analysis, control and calculus of variations, differential equations, dynamical systems, functional analysis, geometry, probability, and topology.

The course requirements are:

<table>
<thead>
<tr>
<th>Abstract Algebra:</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 401</td>
<td>Abstract Algebra I</td>
</tr>
<tr>
<td>MATH 402</td>
<td>Abstract Algebra II</td>
</tr>
<tr>
<td>Analysis:</td>
<td>9</td>
</tr>
<tr>
<td>MATH 423</td>
<td>Introduction to Real Analysis I</td>
</tr>
<tr>
<td>MATH 424</td>
<td>Introduction to Real Analysis II</td>
</tr>
<tr>
<td>MATH 425</td>
<td>Complex Analysis I</td>
</tr>
<tr>
<td>Geometry and topology; one of:</td>
<td>3</td>
</tr>
<tr>
<td>MATH 461</td>
<td>Introduction to Topology</td>
</tr>
<tr>
<td>MATH 462</td>
<td>Algebraic Topology</td>
</tr>
<tr>
<td>MATH 465</td>
<td>Differential Geometry</td>
</tr>
<tr>
<td>MATH 467</td>
<td>Differentiable Manifolds</td>
</tr>
<tr>
<td>18 credit hours of approved course work</td>
<td>18</td>
</tr>
</tbody>
</table>

Total Units | 36 |

A student with a master’s degree in a mathematical subject compatible with our program, as determined by the graduate committee, must take 18 credit hours of approved courses. The graduate committee will determine which of the specific course requirements stated above have been satisfied by the master’s course work.

Applied Mathematics Track
A student in the applied mathematics track must demonstrate knowledge of scientific computing, mathematical modeling, and differential equations. This includes taking qualifying examinations in the areas of computational mathematics and mathematical modeling, and taking certain courses in these three areas, as specified below.

Qualifying Examination
A doctoral student in the applied mathematics track must take written examinations in numerical analysis and in mathematical modeling, as well as an oral examination in his or her chosen area of specialization. Subjects include but are not restricted to fluid mechanics, statistical mechanics, epidemiology, neuroscience, and more traditional specialization. Subjects include but are not restricted to fluid mechanics, statistical mechanics, epidemiology, neuroscience, and more traditional specialization.

<table>
<thead>
<tr>
<th>Application area</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 431</td>
<td>Introduction to Numerical Analysis I</td>
</tr>
<tr>
<td>MATH 432</td>
<td>Numerical Differential Equations</td>
</tr>
<tr>
<td>MATH 433</td>
<td>Numerical Solutions of Nonlinear Systems and Optimization</td>
</tr>
<tr>
<td>MATH 439</td>
<td>Integrated Numerical and Statistical Computations</td>
</tr>
<tr>
<td>MATH 440</td>
<td>Computational Inverse Problems</td>
</tr>
<tr>
<td>MATH 441</td>
<td>Mathematical Modeling</td>
</tr>
<tr>
<td>MATH 445</td>
<td>Introduction to Partial Differential Equations</td>
</tr>
<tr>
<td>MATH 449</td>
<td>Dynamical Models for Biology and Medicine</td>
</tr>
<tr>
<td>MATH 478</td>
<td>Computational Neuroscience</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Life Science Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 431</td>
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<tr>
<td>MATH 432</td>
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<tr>
<td>MATH 433</td>
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<tr>
<td>MATH 439</td>
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<td>MATH 440</td>
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<td>MATH 444</td>
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<td>MATH 445</td>
</tr>
<tr>
<td>MATH 475</td>
</tr>
<tr>
<td>EBME 410</td>
</tr>
<tr>
<td>PHYS 431</td>
</tr>
<tr>
<td>PHYS 460</td>
</tr>
</tbody>
</table>

A student with a master’s degree in a mathematical subject compatible with our program, as determined by the graduate committee, must take 18 credit hours of approved courses, which must include at least 6 credit hours of courses offered outside the Department of Mathematics, Applied Mathematics, and Statistics and at least 9 credit hours offered by the Department of Mathematics, Applied Mathematics, and Statistics. The graduate committee will determine which of the specific course requirements stated above have been satisfied by the master’s course work.

Sample study plans for students with concentrations in scientific computing, imaging, mathematical biology, and stochastics follow. The graduate committee will entertain ideas for other serious study plans or qualifying exam subjects in addition to the most common variants.

Scientific Computing Concentration

<table>
<thead>
<tr>
<th>Total Units</th>
<th>24</th>
</tr>
</thead>
</table>

| 24 hours of approved courses | 24 |

| Total Units | 36 |

| 24 hours of approved courses | 24 |

| Total Units | 36 |

| 24 hours of approved courses | 24 |

* Must include at least 9 hours of courses offered outside the department and at least 9 credit hours offered by the Department of Mathematics, Applied Mathematics, and Statistics.
The dual core of the MS program is mathematical statistics and modern data analysis, with the option of a special Entrepreneurial Track. Expanding from this core, students develop technical facility in a variety of statistical methodologies. This breadth of competence is designed to equip graduates to go beyond the appropriate choice of method for implementation and to be able to adapt these techniques to construct new methods to meet the specific objectives and constraints of new situations.

The MS degree in statistics requires a minimum of 27 hours of approved course work in statistics and related disciplines and an MS research project or a thesis. Each student's program is developed in consultation with the director of graduate studies or a senior faculty mentor and must satisfy the following requirements:

**Master of Science in Statistics**

**Stochastics Concentration**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 432</td>
<td>Numerical Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 433</td>
<td>Numerical Solutions of Nonlinear Systems and Optimization</td>
<td>3</td>
</tr>
<tr>
<td>MATH 439</td>
<td>Integrated Numerical and Statistical Computations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 440</td>
<td>Computational Inverse Problems</td>
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</tr>
<tr>
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<td>Mathematical Modeling</td>
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</tr>
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</tr>
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<td>MATH 449</td>
<td>Dynamical Models for Biology and Medicine</td>
<td>3</td>
</tr>
<tr>
<td>MATH 478</td>
<td>Computational Neuroscience</td>
<td>3</td>
</tr>
</tbody>
</table>

**Application area**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 425</td>
<td>Data Analysis and Linear Models</td>
<td>6</td>
</tr>
<tr>
<td>STAT 426</td>
<td>and Multivariate Analysis and Data Mining</td>
<td></td>
</tr>
</tbody>
</table>

**Application area**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 445</td>
<td>Theoretical Statistics I</td>
<td>6</td>
</tr>
<tr>
<td>STAT 446</td>
<td>and Theoretical Statistics II</td>
<td></td>
</tr>
<tr>
<td>STAT 455</td>
<td>Linear Models</td>
<td>3</td>
</tr>
<tr>
<td>STAT 495A</td>
<td>Consulting Forum</td>
<td>1-3</td>
</tr>
<tr>
<td>STAT 621</td>
<td>M.S. Research Project</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 651</td>
<td>Thesis M.S.</td>
<td></td>
</tr>
</tbody>
</table>

A minimum of six hours of approved graduate-level statistics electives. 6

**Total Units** 25-27

The goals of this program are:

1. to give each student a balanced view of statistical theory and the application of statistics in practice or in substantive research
2. to have the student develop a broad competence in statistical methodology.

The required core course work reflects this balance. The first two requirements are for full-year sequences in data analysis and theory; the third develops the theory underlying linear modeling. The requirement for applications of statistics will be satisfied through intensive participation in the consulting forum; the selection of an MS research project provides additional exposure. Graduate students are also required to participate in a forum or seminar to gain experience in written and oral presentation.

A student coming to school from a position as a professional statistician might choose a statistical problem arising in the workplace as the basis for an MS research project. A student intending to continue graduate work toward a PhD might choose an MS research project to explore the intimate relationship of statistics to substantive fields. Alternatively, either student might choose the thesis option to tailor a methodology to a new setting or to make a first essay at mathematical statistical research.

**Entrepreneurial Track**

The Master of Science in Statistics–Entrepreneurial Track (MSS-ET) is a professional degree designed to provide training in statistics focused on developing data analysis and decision-making skills in industrial, government, and consulting environments where uncertainties and related risks are present. It expands our master’s program in statistics by creating a professional track that includes some business training. The Entrepreneurial Track provides instruction and real-world business experience to students who have a background in statistics and a vision for new and growing ventures. The MSS–ET program requires a minimum of 27 hours.

The required New Venture Creation and Technology Entrepreneurship courses will be offered by the Weatherhead School of Management. Students on internships will sign up for the consulting forum sequence. In addition, students are required to participate in an intensive (up to 30 hours) one-week annual workshop on the industrial use of statistics from the management perspective. This non-credit workshop will take place during the fall or spring undergraduate breaks.

PhD students entering with a bachelor's degree are subject to the same breadth requirements as students pursuing the MS degree in applied mathematics.

**Petitions**

Any exceptions to departmental regulations or requirements must have the formal approval of the department's graduate committee. Such exceptions are to be sought by a written petition, approved by the student's advisory committee or thesis advisor, to the graduate committee.

Any exception to university rules and regulations must be approved by the dean of graduate studies. Such exceptions are to be sought by presenting a written petition to the graduate committee for departmental endorsement and approval prior to forwarding the petition to the dean.
Doctor of Philosophy in Statistics

Please note: Currently, admission to the doctoral program in Statistics is frozen due to reorganization of the program (students are being accepted into the master's program in Statistics). Please check with the department for the latest update.

The doctoral program focuses on research, with a plan of study devoted to the development of statistical methodology or theory with innovative applications. Graduates will be able both to extend the theoretical basis for statistics and to bring statistical thought to scientific research in other fields. The objective of preparing students to collaborate in interdisciplinary work demands breadth as well, so advanced knowledge of a substantive field and participation in the collaborative experience are also integral to the program.

Students planning to enter the doctoral program in statistics should obtain information from the departmental office. Plans of study are prepared individually by the graduate student and a faculty advisor to develop the talents and interests of each student.

Department Faculty

Mary Ann Horn, PhD
(University of Virginia)
Professor and Chair
Partial differential equations, control theory, nonlinear analysis, mathematical biology

Alethea Barbaro, PhD
(University of California, Santa Barbara)
Assistant Professor
Agent-based lattice and off-lattice models; particle to continuum dynamics; kinetic theory at the microscopic, mesoscopic, and macroscopic levels

Jenny Brynjarsdóttir, PhD
(The Ohio State University)
Assistant Professor
Bayesian methodology; Bayesian hierarchical modeling; dimension reduction in space-time modeling; environmental statistics; applications in climate and paleoclimate sciences; uncertainty quantification; model discrepancy

Christopher Butler, MS
(Case Western Reserve University)
Senior Instructor and Theodore M. Focke Professorial Fellow
Teaching of mathematics

Daniela Calvetti, PhD
(University of North Carolina)
James Wood Williamson Professor
Scientific computing; imaging, inverse problems; modeling and simulation in life science

Julia Dobrosotskaya, PhD
(University of California, Los Angeles)
Assistant Professor
Harmonic analysis; PDE; variational methods; signal processing

Weihong Guo, PhD
(University of Florida)
Associate Professor
Image processing, image analysis and their applications in medical imaging and hyperspectral imaging; computer vision; machine learning

David Gurarie, PhD
(Hebrew University, Jerusalem, Israel)
Professor
Applied mathematics: differential equations, dynamical systems, infectious disease modeling, population biology, geophysical fluid dynamics

M. Nicholas Gurski, PhD
(University of Chicago)
Assistant Professor
Category theory and topology, with applications to algebra and mathematical physics

Michael Hurley, PhD
(Northwestern University)
Professor
Dynamical systems, dynamics of cellular automata; dynamics of numerical methods

Steven H. Izen, PhD
(Massachusetts Institute of Technology)
Professor
Image reconstruction from projections, both theoretically and in applied situations

Joel Langer, PhD
(University of California, Santa Cruz)
Professor and Theodore M. Focke Professorial Fellow
Static and dynamics of curves and related physical models; the interplay between geometry and integrable Hamiltonian systems; geometry of finite and infinite dimensional spaces of curves

Marshall J. Leitman, PhD
(Brown University)
Professor
Continuum physics; integral equations; functional analysis; mechanics of materials

Elizabeth Meckes, PhD
(Stanford University)
Associate Professor
Probability theory; probabilistic problems in geometry, topology, and physics; random matrix theory

Mark Meckes, PhD
(Case Western Reserve University)
Associate Professor
Geometry in high dimensions; random matrix theory; geometric probability

Anirban Mondal, PhD
(Texas A&M University)
Assistant Professor
Bayesian Inference, Markov Chain Monte Carlo methods, spatial statistics, inverse problems
David A. Singer, PhD  
(University of Pennsylvania)  
Professor  
Geometry; differential and algebraic geometry of curves, finite and infinite-dimensional spaces of curves, variational problems

Erkki Somersalo, PhD  
(University of Helsinki)  
Professor  
Modeling and simulation of complex biological systems; inverse problems and Bayesian scientific computing; medical imaging

Wanda Strychalski, PhD  
(The University of North Carolina at Chapel Hill)  
Assistant Professor  
Mathematical biology; scientific computing; computational cell biology

Stanislaw J. Szarek, PhD  
(Mathematical Institute, Polish Academy of Science)  
Kerr Professor of Mathematics  
Geometric functional analysis and its applications to study of high-dimensional phenomena including quantum information theory

Peter Thomas, PhD  
(University of Chicago)  
Associate Professor  
Mathematical biology, mathematical neuroscience, information theory and control theory in biology. Stochastic nonlinear dynamics; synchronization, entrainment, and control of neural and motor systems.

Elisabeth Werner, PhD  
(Université Pierre et Marie Curie, Paris VI)  
Professor  
Convex geometry; analysis; probability; applications to approximation theory; mathematical physics; quantum information theory

Patricia Williamson, PhD  
(Bowling Green State University)  
Senior Instructor  
Bayesian analysis; estimation; hypothesis testing

Wojbor A. Woyczynski, PhD  
(Wroclaw University, Poland)  
Professor and Director of the Center for Stochastic and Chaotic Processes in Science and Technology  
Probability theory, stochastic calculus, Levy processes, nonlinear diffusions, chaotic dynamics; mathematical neurosciences, biology, economics, physics and engineering; history of mathematics

Longhua Zhao, PhD  
(The University of North Carolina at Chapel Hill)  
Assistant Professor  
Mathematical modeling; fluid mechanics; scientific computing

Adjunct Faculty

Carsten Schütt, PhD  
(Christian-Albrecht Universität, Kiel)  
Adjunct Professor  
Convex geometry; Banach space theory; functional analysis

Richard Varga, PhD  
(Harvard University)  
Adjunct Professor  
Rational approximation; Riemann hypothesis; Gershgorin disks

MATH Courses

MATH 120. Elementary Functions and Analytic Geometry. 3 Units.  
Polynomial, rational, exponential, logarithmic, and trigonometric functions (emphasis on computation, graphing, and location of roots) straight lines and conic sections. Primarily a precalculus course for the student without a good background in trigonometric functions and graphing and/or analytic geometry. Not open to students with credit for MATH 121 or MATH 125. Prereq: Three years of high school mathematics.

MATH 121. Calculus for Science and Engineering I. 4 Units.  
Functions, analytic geometry of lines and polynomials, limits, derivatives of algebraic and trigonometric functions. Definite integral, antiderivatives, fundamental theorem of calculus, change of variables. Recommended preparation: Three and one half years of high school mathematics. Credit for at most one of MATH 121, MATH 123 and MATH 126 can be applied to hours required for graduation. Counts for CAS Quantitative Reasoning Requirement. Prereq: MATH 120 or a score of 25 on the mathematics diagnostic test.

MATH 122. Calculus for Science and Engineering II. 4 Units.  
Continuation of MATH 121. Exponentials and logarithms, growth and decay, inverse trigonometric functions, related rates, basic techniques of integration, area and volume, polar coordinates, parametric equations. Taylor polynomials and Taylor’s theorem. Credit for at most one of MATH 122, MATH 124, and MATH 126 can be applied to hours required for graduation. Prereq: MATH 121, MATH 123 or MATH 126.

MATH 123. Calculus I. 4 Units.  
Limits, continuity, derivatives of algebraic and transcendental functions, including applications, basic properties of integration. Techniques of integration and applications. Students must have 31/2 years of high school mathematics. Credit for at most one of MATH 121, MATH 123, and MATH 125 can be applied to hours required for graduation. Counts for CAS Quantitative Reasoning Requirement.

MATH 124. Calculus II. 4 Units.  
Review of differentiation. Techniques of integration, and applications of the definite integral. Parametric equations and polar coordinates. Taylor’s theorem. Sequences, series, power series. Complex arithmetic. Introduction to multivariable calculus. Credit for at most one of MATH 122, MATH 124, and MATH 126 can be applied to hours required for graduation. Prereq: MATH 121 and placement by department.

Secondary Faculty

Colin McLarty, PhD  
(Case Western Reserve University)  
Truman P. Handy Professor of Philosophy, Department of Philosophy  
Logic; philosophy of mathematics, history of mathematics
MATH 125. Math and Calculus Applications for Life, Managerial, and Social Sci I. 4 Units.
Discrete and continuous probability; differential and integral calculus of one variable; graphing, related rates, maxima and minima. Integration techniques, numerical methods, volumes, areas. Applications to the physical, life, and social sciences. Students planning to take more than two semesters of introductory mathematics should take MATH 121. Recommended preparation: Three and one half years of high school mathematics. Credit for at most one of MATH 121, MATH 123, and MATH 125 can be applied to hours required for graduation. Counts for CAS Quantitative Reasoning Requirement. Prereq: MATH 120 or a score of 25 or above on the mathematics diagnostic exam.

MATH 126. Math and Calculus Applications for Life, Managerial, and Social Sci II. 4 Units.
Continuation of MATH 125 covering differential equations, multivariable calculus, discrete methods. Partial derivatives, maxima and minima for functions of two variables, linear regression. Differential equations; first and second order equations, systems, Taylor series methods; Newton’s method; difference equations. Credit for at most one of MATH 122, MATH 124, and MATH 126 can be applied to hours required for graduation. Prereq: MATH 121, MATH 123 or MATH 125.

MATH 150. Mathematics from a Mathematician’s Perspective. 3 Units.
An interesting and accessible mathematical topic not covered in the standard curriculum is developed. Students are exposed to methods of mathematical reasoning and historical progression of mathematical concepts. Introduction to the way mathematicians work and their attitude toward their profession. Should be taken in freshman year to count toward a major in mathematics. Prereq: Three and one half years of high school mathematics. Counts for CAS Quantitative Reasoning Requirement.

MATH 201. Introduction to Linear Algebra for Applications. 3 Units.
Matrix operations, systems of linear equations, vector spaces, subspaces, bases and linear independence, eigenvalues and eigenvectors, diagonalization of matrices, linear transformations, determinants. Less theoretical than MATH 307. Appropriate for majors in science, engineering, economics. Prereq: MATH 122, MATH 124 or MATH 126.

MATH 223. Calculus for Science and Engineering III. 3 Units.
Introduction to vector algebra; lines and planes. Functions of several variables; partial derivatives, gradients, chain rule, directional derivative, maxima/minima. Multiple integrals, cylindrical and spherical coordinates. Derivatives of vector valued functions, velocity and acceleration. Vector fields, line integrals, Green’s theorem. Credit for at most one of MATH 223 and MATH 227 can be applied to hours required for graduation. Prereq: MATH 122 or MATH 124.

MATH 224. Elementary Differential Equations. 3 Units.
A first course in ordinary differential equations. First order equations and applications, linear equations with constant coefficients, linear systems, Laplace transforms, numerical methods of solution. Credit for at most one of MATH 224 and MATH 228 can be applied to hours required for graduation. Prereq: MATH 223 or MATH 227.

MATH 227. Calculus III. 3 Units.
Vector algebra and geometry. Linear maps and matrices. Calculus of vector valued functions. Derivatives of functions of several variables. Multiple integrals. Vector fields and line integrals. Credit for at most one of MATH 223 and MATH 227 can be applied to hours required for graduation. Prereq: MATH 124 and placement by the department.

MATH 228. Differential Equations. 3 Units.
Elementary ordinary differential equations: first order equations; linear systems; applications; numerical methods of solution. Credit for at most one of MATH 224 and MATH 228 can be applied to hours required for graduation. Prereq: MATH 227 or placement by the department.

MATH 301. Undergraduate Reading Course. 1 - 3 Units.
Students must obtain the approval of a supervising professor before registration. More than one credit hour must be approved by the undergraduate committee of the department.

MATH 302. Departmental Seminar. 3 Units.
A seminar devoted to understanding the formulation and solution of mathematical problems. SAGES Department Seminar. Students will investigate, from different possible viewpoints, via case studies, how mathematics advances as a discipline—what mathematicians do. The course will largely be in a seminar format. There will be two assignments involving writing in the style of the discipline. Enrollment by permission (limited to majors depending on demand). Counts as SAGES Departmental Seminar.

MATH 303. Elementary Number Theory. 3 Units.
Primes and divisibility, theory of congruencies, and number theoretic functions. Diophantine equations, quadratic residue theory, and other topics determined by student interest. Emphasis on problem solving (formulating conjectures and justifying them). Prereq: MATH 122 or MATH 124.

MATH 304. Discrete Mathematics. 3 Units.
A general introduction to basic mathematical terminology and the techniques of abstract mathematics in the context of discrete mathematics. Topics introduced are mathematical reasoning, Boolean connectives, deduction, mathematical induction, sets, functions and relations, algorithms, graphs, combinatorial reasoning. Offered as EECS 302 and MATH 304. Prereq: MATH 122, MATH 124 or MATH 126.

MATH 305. Introduction to Advanced Mathematics. 3 Units.
A general introduction to basic mathematical terminology and the techniques of abstract mathematics in the context of discrete mathematics. Topics introduced are mathematical reasoning, Boolean connectives, deduction, mathematical induction, sets, functions and relations, algorithms, graphs, combinatorial reasoning. Offered as EECS 302 and MATH 304. Prereq: MATH 122, MATH 124 or MATH 126.

MATH 306. Linear Algebra. 3 Units.
A course in linear algebra that studies the fundamentals of vector spaces, inner product spaces, and linear transformations on an axiomatic basis. Topics include: solutions of linear systems, matrix algebra over the real and complex numbers, linear independence, bases and dimension, eigenvalues and eigenvectors, singular value decomposition, and determinants. Other topics may include least squares, general inner product and normed spaces, orthogonal projections, finite dimensional spectral theorem. This course is required of all students majoring in mathematics and applied mathematics. More theoretical than MATH 201. Prereq: MATH 122 or MATH 124.

MATH 308. Introduction to Abstract Algebra. 3 Units.
A first course in abstract algebra, studied on an axiomatic basis. The major algebraic structures studied are groups, rings and fields. Topics include homomorphisms and quotient structures. This course is required of all students majoring in mathematics. It is helpful, but not necessary, for a student to have taken MATH 307 before MATH 308. Prereq: MATH 122 or MATH 124.
MATH 319. Applied Probability and Stochastic Processes for Biology. 3 Units.
Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419. Prereq: MATH 224 or MATH 223 and BIOL 300 or BIOL 306 and MATH 201 or MATH 307 or consent of instructor.

MATH 321. Fundamentals of Analysis I. 3 Units.
Abstract mathematical reasoning in the context of analysis in Euclidean space. Introduction to formal reasoning, sets and functions, and the number systems. Sequences and series; Cauchy sequences and convergence. Required for all mathematics majors. Additional work required for graduate students. (May not be taken for graduate credit by graduate students in the Department of Mathematics.) Offered as MATH 321 and MATH 421. Prereq: MATH 223 or MATH 227.

MATH 322. Fundamentals of Analysis II. 3 Units.
Continuation of MATH 321. Point-set topology in metric spaces with attention to n-dimensional space; completeness, compactness, connectedness, and continuity of functions. Topics in sequences, series of functions, uniform convergence, Fourier series and polynomial approximation. Theoretical development of differentiation and Riemann integration. Required for all mathematics majors. Additional work required for graduate students. (May not be taken for graduate credit by graduate students in the Department of Mathematics.) Offered as MATH 322 and MATH 422. Prereq: MATH 321.

MATH 324. Introduction to Complex Analysis. 3 Units.

MATH 327. Convexity and Optimization. 3 Units.
Introduction to the theory of convex sets and functions and to the extremes in problems in areas of mathematics where convexity plays a role. Among the topics discussed are basic properties of convex sets (extreme points, facial structure of polytopes), separation theorems, duality and polars, properties of convex functions, minima and maxima of convex functions over convex set, various optimization problems. Offered as MATH 327, MATH 427, and OPRE 427. Prereq: MATH 223 or MATH 227.

MATH 330. Introduction of Scientific Computing. 3 Units.
An introductory survey to Scientific Computing from principles to applications. Topics which will be covered in the course include: solution of linear systems and least squares, approximation and interpolation, solution of nonlinear systems, numerical integration and differentiation, and numerical solution of differential equations. Projects where the numerical methods are used to solve problems from various application areas will be assigned throughout the semester. Prereq: MATH 224 or MATH 228.

MATH 333. Mathematics and Brain. 3 Units.
This course is intended for upper level undergraduate students in Mathematics, Cognitive Science, Biomedical Engineering, Biology or Neuroscience who have an interest in quantitative investigation of the brain and its functions. Students will be introduced to a variety of mathematical techniques needed to model and simulate different brain functions, and to analyze the results of the simulations and of available measured data. The mathematical exposition will be followed—when appropriate—by the corresponding implementation in Matlab. The course will cover some basic topics in the mathematical aspects of differential equations, electromagnetism, Inverse problems and imaging related to brain functions. Validation and falsification of the mathematical models in the light of available experimental data will be addressed. This course will be a first step towards organizing the different brain investigative modalities within a unified mathematical framework. Lectures will include a discussion portion. A final presentation and written report are part of the course requirements. Counts as SAGES Departmental Seminar. Prereq: MATH 224 or MATH 228.

MATH 338. Introduction to Dynamical Systems. 3 Units.
Nonlinear discrete dynamical systems in one and two dimensions. Chaotic dynamics, elementary bifurcation theory, hyperbolicity, symbolic dynamics, structural stability, stable manifold theory. Prereq: MATH 223 or MATH 227.

MATH 343. Theoretical Computer Science. 3 Units.
Introduction to different classes of automata and their correspondence to different classes of formal languages and grammars, computability, complexity and various proof techniques. Offered as EECS 343 and MATH 343. Prereq: MATH 304 and EECS 340.

MATH 351. Senior Project for the Mathematics and Physics Program. 2 Units.
A two-semester course (2 credits per semester) in the joint B.S. in Mathematics and Physics program. Project based on numerical and/or theoretical research under the supervision of a mathematics faculty member, possibly jointly with a faculty member from physics. Study of the techniques utilized in a specific research area and of recent literature associated with the project. Work leading to meaningful results which are to be presented as a term paper and an oral report at the end of the second semester. Supervising faculty will review progress with the student on a regular basis, including detailed progress reports made twice each semester, to ensure successful completion of the work. Counts as SAGES Senior Capstone.
MATH 352. Mathematics Capstone. 3 Units.
Mathematics Senior Project. Students pursue a project based on experimental, theoretical or teaching research under the supervision of a mathematics faculty member, a faculty member from another Case department or a research scientist or engineer from another institution. A departmental Senior Project Coordinator must approve all project proposals and this same person will receive regular oral and written progress reports. Final results are presented at the end of the second semester as a paper in a style suitable for publication in a professional journal as well as an oral report in a public Mathematics Capstone symposium. Counts as SAGES Senior Capstone.

MATH 357. Mathematical Modeling Across the Sciences. 3 Units.
A three credit course on mathematical modeling as it applies to the origins sciences. Students gain practical experience in a wide range of techniques for modeling research questions in cosmology and astrophysics, integrative evolutionary biology (including physical anthropology, ecology, paleontology, and evolutionary cognitive science), and planetary science and astrobiology. Offered as ORIG 301, ORIG 401 and MATH 357. Prereq: ORIG 201, ORIG 202, BIOL 225, MATH 122, CHEM 106 and (PHYS 122 or PHYS 124).

MATH 361. Geometry I. 3 Units.
An introduction to the various two-dimensional geometries, including Euclidean, spherical, hyperbolic, projective, and affine. The course will examine the axiomatic basis of geometry, with an emphasis on transformations. Topics include the parallel postulate and its alternatives, isometries and transformation groups, tilings, the hyperbolic plane and its models, spherical geometry, affine and projective transformations, and other topics. We will examine the role of complex and hypercomplex numbers in the algebraic representation of transformations. The course is self-contained. Counts as SAGES Departmental Seminar. Prereq: MATH 224.

MATH 363. Knot Theory. 3 Units.
An introduction to the mathematical theory of knots and links, with emphasis on the modern combinatorial methods. Reidemeister moves on link projections, ambient and regular isotopies, linking number tricolorability, rational tangles, braids, torus knots, seifert surfaces and genus, the knot polynomials (bracket, X, Jones, Alexander, HOMFLY), crossing numbers of alternating knots and amphicheirality. Connections to theoretical physics, molecular biology, and other scientific applications will be pursued in term projects, as appropriate to the background and interests of the students. Prereq: MATH 223 or MATH 227.

MATH 365. Introduction To Algebraic Geometry. 3 Units.
This is a first introduction to algebraic geometry - the study of solutions of polynomial equations - for advanced undergraduate students. Recent applications of this large and important area include number theory, combinatorics, theoretical physics, coding theory, and robotics. In this course we will learn the basic objects and notions of algebraic geometry. Topics that are planned to be covered are affine and projective varieties, the Zariski topology, the correspondence between ideals and varieties, the sheaf of regular functions, regular and rational maps, dimensions and tangent spaces. Examples such as Grassmannians, curves, and blow-ups will be discussed. Depending on time constraints, we may also touch upon the modern language of schemes, line bundles and the Riemann Roch formula, and algorithmic techniques such as Groebner bases. Prereq: MATH 307 and Coreq: MATH 308.

MATH 376. Mathematical Analysis of Biological Models. 3 Units.
This course focuses on the mathematical methods used to analyze biological models, with examples drawn largely from ecology but also from epidemiology, developmental biology, and other areas. Mathematical topics include equilibrium and stability in discrete and continuous time, some aspects of transient dynamics, and reaction-diffusion equations (steady state, diffusive instabilities, and traveling waves). Biological models include several "classic" models, such as the Lotka-Volterra model, the Ricker model, and Michaelis-Menten/type II/saturating responses. The emphasis is on approximations that lead to analytic solutions, not numerical analysis. An important aspect of this course is translating between verbal and mathematical descriptions: the goal is not just to solve mathematical problems but to extract biological meaning from the answers we find. Offered as BIOL 306 and MATH 376. Prereq: BIOL 300 or MATH 224 or consent of instructor.

MATH 378. Computational Neuroscience. 3 Units.
Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECS 478, MATH 478 and NEUR 478.

MATH 380. Introduction to Probability. 3 Units.

MATH 383. Topics in Probability. 3 Units.
This is a second undergraduate course in probability. Topics may include: Stochastic processes, Markov chains, Brownian motion, martingales, measure-theoretic foundations of probability, quantitative limit theory/ rates of convergence, coupling methods, Fourier methods, and ergodic theory. Prereq: MATH 380.
**MATH 394. Introduction to Information Theory. 3 Units.**
This course is intended as an introduction to information and coding theory with emphasis on the mathematical aspects. It is suitable for advanced undergraduate and graduate students in mathematics, applied mathematics, statistics, physics, computer science and electrical engineering. Course content: Information measures-entropy, relative entropy, mutual information, and their properties. Typical sets and sequences, asymptotic equipartition property, data compression. Channel coding and capacity: channel coding theorem. Differential entropy, Gaussian channel, Shannon-Nyquist theorem. Information theory inequalities (400 level). Additional topics, which may include compressed sensing and elements of quantum information theory. Recommended preparation: MATH 201 or MATH 307. Offered as MATH 394, EECS 394, MATH 494 and EECS 494. Prereq: MATH 223 and MATH 380 or requisites not met permission.

**MATH 400. Mathematics Teaching Practicum. 1 Unit.**
Practicum for teaching college mathematics. Includes preparation of syllabi, exams, lectures. Grading, alternative teaching styles, use of technology, interpersonal relations and motivation. Handling common problems and conflicts.

**MATH 401. Abstract Algebra I. 3 Units.**
Basic properties of groups, rings, modules and fields. Isomorphism theorems for groups; Sylow theorem; nilpotency and solvability of groups; Jordan-Holder theorem; Gauss lemma and Eisenstein's criterion, finitely generated modules over principal ideal domains with applications to abelian groups and canonical forms for matrices; categories and functors; tensor product of modules, bilinear and quadratic forms; field extensions; fundamental theorem of Galois theory, solving equations by radicals. Prereq: MATH 308.

**MATH 402. Abstract Algebra II. 3 Units.**
A continuation of MATH 401. Prereq: MATH 401.

**MATH 405. Advanced Matrix Analysis. 3 Units.**
An advanced course in linear algebra and matrix theory. Topics include variational characterizations of eigenvalues of Hermitian matrices, matrix and vector norms, characterizations of positive definite matrices, singular value decomposition and applications, perturbation of eigenvalues. This course is more theoretical than MATH 431, which emphasizes computational aspects of linear algebra Prereq: MATH 307.

**MATH 406. Mathematical Logic and Model Theory. 3 Units.**
Abstract mathematical reasoning in the context of analysis in Euclidean space. Introduction to formal reasoning, sets and functions, and the number systems. Sequences and series; Cauchy sequences and convergence. Required for all mathematics majors. Additional work required for graduate students. (May not be taken for graduate credit by graduate students in the Department of Mathematics.) Offered as MATH 321 and MATH 421.

**MATH 422. Fundamentals of Analysis II. 3 Units.**
Continuation of MATH 421. Point-set topology in metric spaces with attention to n-dimensional space; completeness, compactness, connectedness, and continuity of functions. Topics in sequences, series of functions, uniform convergence, Fourier series and polynomial approximation. Theoretical development of differentiation and Riemann integration. Required for all mathematics majors. Additional work required for graduate students. (May not be taken for graduate credit by graduate students in the Department of Mathematics.) Offered as MATH 322 and MATH 422. Prereq: MATH 421.

**MATH 423. Introduction to Real Analysis I. 3 Units.**
General theory of measure and integration. Measures and outer measures. Lebesgue measure on n-space. Integration. Convergence theorems. Product measures and Fubini's theorem. Signed measures. Lebesgue measure on n-space. Integration. Convergence. Required for all mathematics majors. Additional work required for graduate students. (May not be taken for graduate credit by graduate students in the Department of Mathematics.) Offered as MATH 321 and MATH 421.

**MATH 424. Introduction to Real Analysis II. 3 Units.**
MATH 425. Complex Analysis I. 3 Units.
Analytic functions. Integration over paths in the complex plane. Index of a point with respect to a closed path; Cauchy's theorem and Cauchy's integral formula; power series representation; open mapping theorem; singularities; Laurent expansion; residue calculus; harmonic functions; Poisson's formula; Riemann mapping theorem. More theoretical and at a higher level than MATH 324. Prereq: MATH 322 or MATH 422.

MATH 427. Convexity and Optimization. 3 Units.
Introduction to the theory of convex sets and functions and to the extremes in problems in areas of mathematics where convexity plays a role. Among the topics discussed are basic properties of convex sets (extreme points, facial structure of polytopes), separation theorems, duality and polars, properties of convex functions, minima and maxima of convex functions over convex set, various optimization problems. Offered as MATH 327, MATH 427, and OPRE 427.

MATH 431. Introduction to Numerical Analysis I. 3 Units.
Numerical linear algebra for scientists and engineers. Matrix and vector norms, computer arithmetic, conditioning and stability, orthogonality.

MATH 432. Numerical Differential Equations. 3 Units.
Numerical solution of differential equations for scientists and engineers.
Finite difference schemes. Introduction to the finite element method.
Introduction to multigrid techniques. The diffusion equation: numerical schemes and stability analysis. Introduction to hyperbolic equations.
MATLAB will be used in this course. Prereq: MATH 224 or MATH 228.

MATH 433. Numerical Solutions of Nonlinear Systems and Optimization. 3 Units.
The course provides an introduction to numerical solution methods for systems of nonlinear equations and optimization problems. The course is suitable for upper-undergraduate and graduate students with some background in calculus and linear algebra. Knowledge of numerical linear algebra is helpful. Among the topics which will be covered in the course are Nonlinear systems in one variables; Newton's method for nonlinear equations and unconstrained minimization; Quasi-Newton methods; Global convergence of Newton's methods and line searches; Trust region approach; Secant methods; Nonlinear least squares. Prereq: MATH 223 or MATH 227, and MATH 431 or permission.

MATH 434. Optimization of Dynamic Systems. 3 Units.
Fundamentals of dynamic optimization with applications to control.

MATH 435. Ordinary Differential Equations. 3 Units.
A second course in ordinary differential equations. Existence, uniqueness, and continuation of solutions of ODE. Linear systems, fundamental matrix, qualitative methods (phase plane). Dependence on initial data and parameters (Gronwall's inequality, nonlinear variation of parameters). Stability for linear and nonlinear equations, linearization, Poincare-Bendixson theory. Additional topics may include regular and singular perturbation methods, autonomous oscillations, entrainment of forced oscillators, and bifurcations. Prereq: MATH 224 and either MATH 201 or MATH 307.

MATH 439. Integrated Numerical and Statistical Computations. 3 Units.
This course will embed numerical methods into a Bayesian framework. The statistical framework will make it possible to integrate a priori information about the unknowns and the error in the data directly into the most efficient numerical methods. A lot of emphasis will be put on understanding the role of the priors, their encoding into fast numerical solvers, and how to translate qualitative or sample-based information--or lack thereof--into a numerical scheme. Confidence on computed results will also be discussed from a Bayesian perspective, at the light of the given data and a priori information. The course should be of interest to anyone working on signal and image processing statistics, numerical analysis and modeling. Recommended Preparation: MATH 431. Offered as MATH 439 and STAT 439.

MATH 440. Computational Inverse Problems. 3 Units.
This course will introduce several computational methods for solving inverse problems under different conditions. First the classical regularization methods will be introduced, and the computational challenges they pose, will be addressed. Following this, the statistical methods for solving inverse problems will be studied and their computer implementation discussed. We will combine the two approaches to best exploit their potentials. Applications arising from various areas of science, engineering, and medicine will be discussed throughout the course.

MATH 441. Mathematical Modeling. 3 Units.
Mathematics is a powerful language for describing real world phenomena and providing predictions that otherwise are hard or impossible to obtain. The course gives the students pre-requisites for translating qualitative descriptions given in the professional non-mathematical language into the quantitative language for mathematics. While the variety in the subject matter is wide, some general principles and methodologies that a modeler can pursue are similar in many applications. The course focuses on these similarities. The course is based on representative case studies that are discussed and analyzed in the classroom, the emphasis being on general principles of developing and analyzing mathematical models. The examples will be taken from different fields of science and engineering, including life sciences, environmental sciences, biomedical engineering and physical sciences. Modeling relies increasingly on computation, so the students should have basic skills for using computers and programs like Matlab or Mathematica. Prereq: MATH 224 or MATH 228.

MATH 444. Mathematics of Data Mining and Pattern Recognition. 3 Units.
This course will give an introduction to a class of mathematical and computational methods for the solution of data mining and pattern recognition problems. By understanding the mathematical concepts behind algorithms designed for mining data and identifying patterns, students will be able to modify them suitable for specific applications. Particular emphasis will be given to matrix factorization techniques. The course requirements will include the implementations of the methods in MATLAB and their application to practical problems. Prereq: MATH 201 or MATH 307.
MATH 445. Introduction to Partial Differential Equations. 3 Units.
Method of characteristics for linear and quasilinear equations. Second order equations of elliptic, parabolic, type; initial and boundary value problems. Method of separation of variables, eigenfunction expansions, Sturm-Liouville theory. Fourier, Laplace, Hankel transforms; Bessel functions, Legendre polynomials. Green's functions. Examples include: heat diffusion, Laplace's equation, wave equations, one dimensional gas dynamics and others. Appropriate for seniors and graduate students in science, engineering, and mathematics. Prereq: MATH 201 or MATH 307 and MATH 224 or MATH 228.

MATH 446. Numerical Methods for Partial Differential Equations. 3 Units.
This course is an introduction to numerical methods of PDEs, and in particular, to finite element methods (FEM), emphasizing the interconnection between the functional analytic viewpoint of PDEs and the practical and effective computation of the numerical approximations. In particular, the emphasis is on showing that many of the useful and elegant ideas in finite dimensional linear algebra have a natural counterpart in the infinite dimensional setting of Hilbert spaces, and that the same techniques that guarantee the existence and uniqueness of the solutions in fact provide also stable computational methods to approximate the solutions. The topics covered in this course include Fourier analysis, weak derivatives, weak forms, generalized functions; Sobolev spaces, trace theorem, compact embedding theorems, Poincare inequalities; Riesz theory, Fredholm theory; Finite Element Method (FEM): grid generation, existence, stability and convergence of solutions for elliptic problems; Semi-discretization of parabolic and hyperbolic equations; Stiffness; Numerical solution of linear systems by iterative methods. A quintessential part of this course comprises numerical implementation of the finite element method. Matlab is used as the programming tool both in demonstrations and examples in the class as well as in homework assignments. Recommended Preparation: linear algebra, multivariate calculus, and ordinary differential equations.

MATH 449. Dynamical Models for Biology and Medicine. 3 Units.
Introduction to discrete and continuous dynamical models with applications to biology and medicine. Topics include: population dynamics and ecology; models of infectious diseases; population genetics and evolution; biological motion (reaction-diffusion and chemotaxis); Molecular and cellular biology (biochemical kinetics, metabolic pathways, immunology). The course will introduce students to the basic mathematical concepts and techniques of dynamical systems theory (equilibria, stability, bifurcations, discrete and continuous dynamics, diffusion and wave propagation, elements of system theory and control). Mathematical exposition is supplemented with introduction to computer tools and techniques (Mathematica, Matlab). Prereq: MATH 224 or MATH 228, or BIOL/EBME 300, and MATH 201.

MATH 461. Introduction to Topology. 3 Units.

MATH 462. Algebraic Topology. 3 Units.
The fundamental group and covering spaces; van Kampen's theorem. Higher homotopy groups; long-exact sequence of a pair. Homology theory; chain complexes; short and long exact sequences; Mayer-Vietoris sequence. Homology of surfaces and complexes; applications. Prereq: MATH 461.

MATH 465. Differential Geometry. 3 Units.
Manifolds and differential geometry. Vector fields; Riemannian metrics; curvature; intrinsic and extrinsic geometry of surfaces and curves; structural equations of Riemannian geometry; the Gauss-Bonnet theorem. Prereq: MATH 321.

MATH 467. Differentiable Manifolds. 3 Units.
Differentiable manifolds and structures on manifolds. Tangent and cotangent bundle; vector fields; differential forms; tensor calculus; integration and Stokes' theorem. May include Hamiltonian systems and their formulation on manifolds; symplectic structures; connections and curvature; foliations and integrability. Prereq: MATH 322.

MATH 471. Advanced Engineering Mathematics. 3 Units.

MATH 473. Introduction to Mathematical Image Processing and Computer Vision. 3 Units.
This course introduces fundamental mathematics techniques for image processing and computer vision (IPCV). It is accessible to upper level undergraduate and graduate students from mathematics, sciences, engineering and medicine. Topics include but are not limited to image denoising, contrast enhancement, image compression, image segmentation and pattern recognition. Main tools are discrete Fourier analysis and wavelets, plus some statistics, optimization and a little calculus of variation and partial differential equations if time permitting. Students gain a solid theoretical background in IPCV modeling and computing, and master hands-on application experiences. Upon completion of the course, students will have clear understanding of classical methods, which will help them develop new methodical approaches for imaging problems arising in a variety of fields. Recommended preparation: Some coursework in scientific computing and ability to program in (or willingness to learn) a language such as Matlab or C/C++. Prereq: MATH 330 or MATH 431 or equivalent.

MATH 475. Mathematics of Imaging in Industry and Medicine. 3 Units.
The mathematics of image reconstruction; properties of radon transform, relation to Fourier transform; inversion methods, including convolution, backprojection, rho-filtered layergram, algebraic reconstruction technique (ART), and orthogonal polynomial expansions. Reconstruction from fan beam geometry, limited angle techniques used in MRI; survey of applications. Recommended preparation: PHYS 431 or MATH 471.

MATH 478. Computational Neuroscience. 3 Units.
Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECS 478, MATH 478 and NEUR 478.
MATH 491. Probability I. 3 Units.

MATH 492. Probability II. 3 Units.

MATH 494. Introduction to Information Theory. 3 Units.
This course is intended as an introduction to information and coding theory with emphasis on the mathematical aspects. It is suitable for advanced undergraduate and graduate students in mathematics, applied mathematics, statistics, physics, computer science and electrical engineering. Course content: Information measures-entropy, relative entropy, mutual information, and their properties. Typical sets and sequences, asymptotic equipartition property, data compression. Channel coding and capacity: channel coding theorem, Differential entropy, Gaussian channel, Shannon-Nyquist theorem. Information theory inequalities (400 level). Additional topics, which may include compressed sensing and elements of quantum information theory. Recommended preparation: MATH 201 or MATH 307. Offered as MATH 394, EECS 394, MATH 494 and EECS 494.

MATH 497. Stochastic Models: Time Series and Markov Chains. 3 Units.
Introduction to stochastic modeling of data. Emphasis on models and statistical analysis of data with a significant temporal and/or spatial structure. This course will analyze time and space dependent random phenomena from two perspectives: Stationary Time Series: Spectral representation of deterministic signals, autocorrelation. Power spectra. Transmission of stationary signals through linear filters. Optimal filter design, signal-to-noise ratio. Gaussian signals and correlation matrices. Spectral representation and computer simulation of stationary signals. Discrete Markov Chains: Transition matrices, recurrences and the first step analysis. Steady rate. Recurrence and ergodicity, empirical averages. Long run behavior, convergence to steady state. Time to absorption. Eigenvalues and nonhomogeneous Markov chains. Introduction to Gibbs fields and Markov Chain Monte Carlo (MCMC). This course is related to STAT 538 but can be taken independently of it. Offered as: MATH 497 and STAT 437. Prereq: STAT 243/244 (as a sequence) or STAT 312 or STAT 313 or STAT 332 or STAT 333 or STAT 345 or MATH 380 or MATH 491 or Requisites Not Met permission.

MATH 499. Special Topics. 3 Units.
Special topics in mathematics.

MATH 528. Analysis Seminar. 1 - 3 Units.
Continuing seminar on areas of current interest in analysis. Allows graduate and advanced undergraduate students to become involved in research. Topics will reflect interests and expertise of the faculty and may include functional analysis, convexity theory, and their applications. May be taken more than once for credit. Consent of department required.

MATH 535. Applied Mathematics Seminar. 1 - 3 Units.
Continuing seminar on areas of current interest in applied mathematics. Allows graduate and advanced undergraduate students to become involved in research. Topics will reflect interests and expertise of the faculty and may include topics in applied probability and stochastic processes, continuum mechanics, numerical analysis, mathematical physics or mathematical biology. May be taken more than once for credit.

MATH 549. Mathematical Life Sciences Seminar. 1 - 3 Units.
Continuing seminar on areas of current interest in the applications of mathematics to the life sciences. Allows graduate and advanced undergraduate students to become involved in research. Topics will reflect interests and expertise of the faculty and may include mathematical biology, computational neuroscience, mathematical modeling of biological systems, models of infectious diseases, computational cell biology, mathematical ecology and mathematical biomedicine broadly constructed. May be taken more than once for credit.

MATH 598. Stochastic Models: Diffusive Phenomena and Stochastic Differential Equations. 3 Units.
Introduction to stochastic modeling of data. Emphasis on models and statistical analysis of data with significant temporal and/or spatial structure. This course will analyze time and space dependent random phenomena from two perspectives: Brownian motion and diffusive processes: Classification of stochastic processes, finite dimensional distributions, random walks and their scaling limits, Brownian motion and its paths properties, general diffusive processes, Fokker-Planck-Kolmogorov equations, Poisson and point processes, heavy tail diffusions, Levy processes, tempered stable diffusions. Stochastic calculus and stochastic differential equations: Wiener random integrals, mean-square theory, Brownian stochastic integrals and Ito formula, stochastic integrals for Levy processes, martingale property, basic theory and applications of stochastic differential equations. This course is related to STAT 437 but can be taken independently of it. Offered as MATH 598 and STAT 538.

MATH 601. Reading and Research Problems. 1 - 18 Units.
Presentation of individual research, discussion, and investigation of research papers in a specialized field of mathematics.

MATH 651. Thesis (M.S.). 1 - 18 Units.
Presentation of individual research, discussion, and investigation of research papers in a specialized field of mathematics.

MATH 701. Dissertation (Ph.D.). 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

STAT Courses

STAT 201. Basic Statistics for Social and Life Sciences. 3 Units.
Designed for undergraduates in the social sciences and life sciences who need to use statistical techniques in their fields. Descriptive statistics, probability models, sampling distributions. Point and confidence interval estimation, hypothesis testing. Elementary regression and analysis of variance. Not for credit toward major or minor in Statistics. Counts for CAS Quantitative Reasoning Requirement.
STAT 201R. Basic Statistics for Social and Life Sciences Using R Programming. 3 Units.
Designed for undergraduates in the social sciences and life sciences who need to use statistical techniques in their fields. Descriptive statistics, probability models, sampling distributions. Point and confidence interval estimation, hypothesis testing. Elementary regression and analysis of variance. Not for credit toward major or minor in Statistics. Students may earn credit for only one of the following courses: STAT 201, STAT 201R, ANTH 319, PSCL 282 or SYBB 201R. Offered as STAT 201R and SYBB 201R.

STAT 243. Statistical Theory with Application I. 3 Units.

STAT 244. Statistical Theory with Application II. 3 Units.

STAT 312. Basic Statistics for Engineering and Science. 3 Units.
For advanced undergraduate students in engineering, physical sciences, life sciences. Comprehensive introduction to probability models and statistical methods of analyzing data with the object of formulating statistical models and choosing appropriate methods for inference from experimental and observational data and for testing the model's validity. Balanced approach with equal emphasis on probability, fundamental concepts of statistics, point and interval estimation, hypothesis testing, analysis of variance, design of experiments, and regression modeling. Note: Credit given for only one (1) of STAT 312, 312R, 313, 333, 433. Prereq: MATH 122 or equivalent.

STAT 312R. Basic Statistics for Engineering and Science Using R Programming. 3 Units.
For advanced undergraduate students in engineering, physical sciences, life sciences. Comprehensive introduction to probability models and statistical methods of analyzing data with the object of formulating statistical models and choosing appropriate methods for inference from experimental and observational data and for testing the model's validity. Balanced approach with equal emphasis on probability, fundamental concepts of statistics, point and interval estimation, hypothesis testing, analysis of variance, design of experiments, and regression modeling. Note: Credit given for only one (1) of STAT 312, 312R, STAT 313, STAT 333, STAT 433 or SYBB 312R. Offered as STAT 312R and SYBB 312R. Prereq: MATH 122 or equivalent.

STAT 313. Statistics for Experimenters. 3 Units.
For advanced undergraduates in engineering, physical sciences, life sciences. Comprehensive introduction to modeling data and statistical methods of analyzing data. General objective is to train students in formulating statistical models, in choosing appropriate methods for inference from experimental and observational data and to test the validity of these models. Focus on practicalities of inference from experimental data. Inference for curve and surface fitting to real data sets. Designs for experiments and simulations. Student generation of experimental data and application of statistical methods for analysis. Critique of model; use of regression diagnostics to analyze errors. Note: Credit given for only one (1) of STAT 312, 312R, 313, 333, 433. Prereq: MATH 122 or equivalent.

STAT 317. Actuarial Science I. 3 Units.
Practical knowledge of the theory of interest in both finite and continuous time. That knowledge should include how these concepts are used in the various annuity functions, and apply the concepts of present and accumulated value for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, duration, asset/liability management, investment income, capital budgeting, and contingencies. Valuation of discrete and continuous streams of payments, including the case in which the interest conversion period differs from the payment period will be considered. Application of interest theory to amortization of lump sums, fixed income securities, depreciation, mortgages, etc., as well as annuity functions in a broad finance context will be covered. Topics covered include areas examined in the American Society of Actuaries Exam 2. Offered as STAT 317 and STAT 417. Prereq: MATH 122 or MATH 126 or requisites not met permission.

STAT 318. Actuarial Science II. 3 Units.
Theory of life contingencies. Life table analysis for simple and multiple decrement functions. Life and special annuities. Life insurance and reserves for life insurance. Statistical issues for prediction from actuarial models. Topics covered include areas examined in the American Society of Actuaries Exam 3. Offered as STAT 318 and STAT 418. Prereq: STAT 312 or STAT 317 or STAT 345 or requisites not met permission.

STAT 325. Data Analysis and Linear Models. 3 Units.
Basic exploratory data analysis for univariate response with single or multiple covariates. Graphical methods and data summarization, model-fitting using S-plus computing language. Linear and multiple regression. Emphasis on model selection criteria, on diagnostics to assess goodness of fit and interpretation. Techniques include transformation, smoothing, median polish, robust/resistant methods. Case studies and analysis of individual data sets. Notes of caution and some methods for handling bad data. Knowledge of regression is helpful. Offered as STAT 325 and STAT 425. Prereq: STAT 207 or STAT 243 or STAT 312 or PQHS/EPBI 431 or PQHS/EPBI 441 or PQHS/EPBI 458.

STAT 326. Multivariate Analysis and Data Mining. 3 Units.
STAT 326. Statistics for Signal Processing. 3 Units.
For advanced undergraduate students or beginning graduate students in engineering, physical sciences, life sciences. Introduction to probability models and statistical methods. Emphasis on probability as relative frequencies. Derivation of conditional probabilities and memoryless channels. Joint distribution of random variables, transformations, autocorrelation, series of irregular observations, stationarity. Random harmonic signals with noise, random phase and/or random amplitude. Gaussian and Poisson signals. Modulation and averaging properties. Transmission through linear filters. Power spectra, bandwidth, white and colored noise. ARMA processes and forecasting. Optimal linear systems, signal-to-noise ratio, Wiener filter. Completion of additional assignments required from graduate students registered in this course. Offered as STAT 332 and STAT 432. Prereq: MATH 122.

STAT 333. Uncertainty in Engineering and Science. 3 Units.
Phenomena of uncertainty appear in engineering and science for various reasons and can be modeled in different ways. The course integrates the mainstream ideas in statistical data analysis with models of uncertain phenomena stemming from three distinct viewpoints: algorithmic/computational complexity, classical probability theory; and chaotic behavior of nonlinear systems. Descriptive statistics, estimation procedures and hypothesis testing (including design of experiments). Random number generators and their testing. Monte Carlo Methods. Mathematica notebooks and simulations will be used. Note: Credit given for only one (1) of STAT 312, 312R, 313, 333, 433. Graduate students are required to do an extra project. Offered as STAT 333 and STAT 433. Prereq: MATH 122 or MATH 223.

STAT 345. Theoretical Statistics I. 3 Units.
Topics provide the background for statistical inference. Random variables; distribution and density functions; transformations, expectation. Common univariate distributions. Multiple random variables; joint, marginal and conditional distributions; hierarchical models, covariance. Distributions of sample quantities, distributions of sums of random variables, distributions of order statistics. Methods of statistical inference. Offered as STAT 345, STAT 445, and PQHS 481. Prereq: MATH 122 or MATH 223 or Coreq: PQHS/EPBI 431.

STAT 346. Theoretical Statistics II. 3 Units.
Point estimation: maximum likelihood, moment estimators. Methods of evaluating estimators including mean squared error, consistency, "best" unbiased and sufficiency. Hypothesis testing; likelihood ratio and union-intersection tests. Properties of tests including power function, bias. Interval estimation by inversion of test statistics, use of pivotal quantities. Application to regression. Graduate students are responsible for mathematical derivations, and full proofs of principal theorems. Offered as STAT 346, STAT 446 and PQHS 482. Prereq: STAT 345 or STAT 445 or PQHS/EPBI 481.

STAT 395. Senior Project in Statistics. 3 Units.
An individual project done under faculty supervision involving the investigation and statistical analysis of a real problem encountered in university research or an industrial setting. Written report. Counts as SAGES Senior Capstone.

STAT 412. Statistics for Design and Analysis in Engineering and Science. 3 Units.
For graduate students (primarily) and advanced undergraduates in engineering, physical sciences, and life sciences. After basic statistical concepts are reviewed, the remainder of the course consists of a comprehensive introduction to statistical methods of designing experiments and analyzing data. The general objective is to train students in statistical modeling and in the choice of experimental designs to use in scientific investigations. A variety of experimental designs are covered, and regression analysis is presented as the primary technique for analyzing data from designed experiments, and in discriminating between various possible statistical models. The course is oriented toward graduate students engaged in or embarking on research. Prereq: MATH 122.

STAT 417. Actuarial Science I. 3 Units.
Practical knowledge of the theory of interest in both finite and continuous time. That knowledge should include how these concepts are used in the various annuity functions, and apply the concepts of present and accumulated value for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, duration, asset/liability management, investment income, capital budgeting, and contingencies. Valuation of discrete and continuous streams of payments, including the case in which the interest conversion period differs from the payment period will be considered. Application of interest theory to amortization of lump sums, fixed income securities, depreciation, mortgages, etc., as well as annuity functions in a broad finance context will be covered. Topics covered include areas examined in the American Society of Actuaries Exam 2. Offered as STAT 317 and STAT 417. Prereq: MATH 122 or MATH 126 or requisites not met permission.

STAT 418. Actuarial Science II. 3 Units.
Theory of life contingencies. Life table analysis for simple and multiple decrement functions. Life and special annuities. Life insurance and reserves for life insurance. Statistical issues for prediction from actuarial models. Topics covered include areas examined in the American Society of Actuaries Exam 3. Offered as STAT 318 and STAT 418. Prereq: STAT 312 or STAT 313 or STAT 435 or requisites not met permission.

STAT 425. Data Analysis and Linear Models. 3 Units.
Basic exploratory data analysis for univariate response with single or multiple covariates. Graphical methods and data summarization, model-fitting using S-plus computing language. Linear and multiple regression. Emphasis on model selection criteria, on diagnostics to assess goodness of fit and interpretation. Techniques include transformation, smoothing, median polish, robust/resistant methods. Case studies and analysis of individual data sets. Notes of caution and some methods for handling bad data. Knowledge of regression is helpful. Offered as STAT 325 and STAT 425.

STAT 426. Multivariate Analysis and Data Mining. 3 Units.
**STAT 432. Statistics for Signal Processing. 3 Units.**
For advanced undergraduate students or beginning graduate students in engineering, physical sciences, life sciences. Introduction to probability models and statistical methods. Emphasis on probability as relative frequencies. Derivation of conditional probabilities and memoryless channels. Joint distribution of random variables, transformations, autocorrelation, series of irregular observations, stationarity. Random harmonic signals with noise, random phase and/or random amplitude. Gaussian and Poisson signals. Modulation and averaging properties. Transmission through linear filters. Power spectra, bandwidth, white and colored noise. ARMA processes and forecasting. Optimal linear systems, signal-to-noise ratio, Wiener filter. Completion of additional assignments required from graduate students registered in this course. Offered as STAT 332 and STAT 432. Prereq: MATH 122.

**STAT 433. Uncertainty in Engineering and Science. 3 Units.**
Phenomena of uncertainty appear in engineering and science for various reasons and can be modeled in different ways. The course integrates the mainstream ideas in statistical data analysis with models of uncertain phenomena stemming from three distinct viewpoints: algorithmic/computational complexity; classical probability theory; and chaotic behavior of nonlinear systems. Descriptive statistics, estimation procedures and hypothesis testing (including design of experiments). Random number generators and their testing. Monte Carlo Methods. Mathematica notebooks and simulations will be used. Note: Credit given for only one (1) of STAT 312, 312R, 313, 333, 433. Graduate students are required to do an extra project. Offered as STAT 333 and STAT 433. Prereq: MATH 122 or MATH 223.

**STAT 437. Stochastic Models: Time Series and Markov Chains. 3 Units.**
Introduction to stochastic modeling of data. Emphasis on models and statistical analysis of data with a significant temporal and/or spatial structure. This course will analyze time and space dependent random phenomena from two perspectives: Stationary Time Series: Spectral representation of deterministic signals, autocorrelation, Power spectra. Transmission of stationary signals through linear filters. Optimal filter design, signal-to-noise ratio. Gaussian signals and correlation matrices. Spectral representation and computer simulation of stationary signals. Discrete Markov Chains: Transition matrices, recurrences and the first step analysis. Steady state. Recurrence and ergodicity, empirical averages, Long run behavior, convergence to steady state. Time to absorption. Eigenvalues and nonhomogeneous Markov chains. Introduction to Gibbs fields and Markov Chain Monte Carlo (MCMC). This course is related to STAT 538 but can be taken independently of it. Offered as: MATH 497 and STAT 437. Prereq: STAT 243/244 (as a sequence) or STAT 312 or STAT 313 or STAT 322 or STAT 333 or STAT 345 or MATH 380 or MATH 491 or Requisits Not Met permission.

**STAT 439. Integrated Numerical and Statistical Computations. 3 Units.**
This course will embed numerical methods into a Bayesian framework. The statistical framework will make it possible to integrate a priori information about the unknowns and the error in the data directly into the most efficient numerical methods. A lot of emphasis will be put on understanding the role of the priors, their encoding into fast numerical solvers, and how to translate qualitative or sample-based information—or lack thereof—into a numerical scheme. Confidence on computed results will also be discussed from a Bayesian perspective, at the light of the given data and a priori information. The course should be of interest to anyone working on signal and image processing statistics, numerical analysis and modeling. Recommended Preparation: MATH 431. Offered as MATH 439 and STAT 439.

**STAT 445. Theoretical Statistics I. 3 Units.**
Topics provide the background for statistical inference. Random variables; distribution and density functions; transformations, expectation. Common univariate distributions. Multiple random variables; joint, marginal and conditional distributions; hierarchical models, covariance. Distributions of sample quantities, distributions of sums of random variables, distributions of order statistics. Methods of statistical inference. Offered as STAT 345, STAT 445, and PQHS 481. Prereq: MATH 122 or MATH 223 or Coreq: PQHS/EPBI 431.

**STAT 446. Theoretical Statistics II. 3 Units.**
Point estimation: maximum likelihood, moment estimators. Methods of evaluating estimators including mean squared error, consistency, "best" unbiased and sufficiency. Hypothesis testing: likelihood ratio and union-intersection tests. Properties of tests including power function, bias. Interval estimation by inversion of test statistics, use of pivotal quantities. Application to regression. Graduate students are responsible for mathematical derivations, and full proofs of principal theorems. Offered as STAT 346, STAT 446 and PQHS 482. Prereq: STAT 345 or STAT 445 or PQHS/EPBI 481.

**STAT 448. Bayesian Theory with Applications. 3 Units.**
Principles of Bayesian theory, methodology and applications. Methods for forming prior distributions using conjugate families, reference priors and empirically-based priors. Derivation of posterior and predictive distributions and their moments. Properties when common distributions such as binomial, normal or other exponential family distributions are used. Hierarchical models. Computational techniques including Markov chain, Monte Carlo and importance sampling. Extensive use of applications to illustrate concepts and methodology. Recommended preparation: STAT 445.

**STAT 455. Linear Models. 3 Units.**

**STAT 491. Graduate Student Seminar. 1 - 2 Units.**
Seminar run collaboratively by graduate students to investigate an area of current research, the topic chosen each semester. All graduate students participate in presentation of material each semester. Satisfies requirement for every full-time graduate student to enroll in a participatory seminar every semester while registered in any graduate degree program. Recommended preparation: Graduate standing.

**STAT 495A. Consulting Forum. 1 - 3 Units.**
This course unifies what students have learned in their course work to apply their knowledge in consulting. It recognizes the fact that the essence of the statistical profession is continuing interaction with practitioners in the sciences, engineering, medicine, economics, etc. The course presents the views of prominent experts in the field as obtained from the literature and other sources. The responsibilities of the consultant and the client are discussed. Sample consulting problems are presented and strategies for solving them are provided. Prereq: STAT 325 or STAT 425.
provide students with a broad understanding of the many opportunities
language skills. We also run our own study abroad programs: two French
in order to immerse themselves in a foreign culture and perfect their
language and culture study offer. The department has strong

Undergraduate Programs
The Department of Modern Languages and Literatures offers courses

Placement Procedure
Students with prior experience in French, German, or Spanish, however
gained (e.g., in high school, with or without AP courses, at another
institutions, via study abroad), must take a placement examination
before the first week of the semester in which they enroll in one of those
languages. Placement depends both on examination results and on
consultation with individual faculty members.

Majors
Chinese, French, German, Japanese Studies, and Spanish
Majors in Chinese, French, German, Japanese Studies, and Spanish are
expected: 1) to acquire the ability to understand, speak, read, and write
the language(s) of their choice; and 2) to develop a sound understanding
of the relevant cultures and literatures. The major in French, German,
oral Spanish consists of 30-32 hours of course work and will vary based
on students’ background in the language. The major in Chinese and
Japanese Studies requires a minimum of 35 credit hours. Individual
counseling and placement tests are provided by the department.

Course requirements are as follows:

• For students placed into the 200 level: 201-202 and eight courses at
  the 300 level taught in the target language, or six 300-level courses
  plus two related courses.

• For students placed into the 300-level: ten 300-level courses taught
  in the target language, or eight 300-level courses plus two related
  courses.

Related courses are those outside the department which are closely
related to Chinese, French, German, Japanese, and Spanish cultures, as
well as those departmental courses cross-listed with World Literature.

Additional Information for French Major

• Students who take both FRCH 311 and 312 may count only one of these
toward the major.

• At least two of the 300-level courses should be numbered above 320 and
taught in French.

The Department of Modern Languages and Literatures offers courses of study leading to the Bachelor of Arts in Chinese, French, German, Japanese Studies, and Spanish. In addition, the department offers minors in Hebrew, Italian, and Russian, as well as course work in Arabic and Portuguese. Except in the case of courses cross-listed with the World Literature Program and other interdisciplinary programs, all courses in modern languages and literatures are taught primarily in the target language. In addition to class meetings, work outside of class with audio materials is an integral part of all elementary and intermediate language courses taught by the department. Career opportunities exist in college and university teaching, translation and interpretation, diplomatic and other government service, business, international nonprofit agencies, and the arts, and are often enhanced by a double major.

Placement Procedure
Students with prior experience in French, German, or Spanish, however
gained (e.g., in high school, with or without AP courses, at another
institutions, via study abroad), must take a placement examination
before the first week of the semester in which they enroll in one of those
languages. Placement depends both on examination results and on
consultation with individual faculty members.

Majors
Chinese, French, German, Japanese Studies, and Spanish
Majors in Chinese, French, German, Japanese Studies, and Spanish are
expected: 1) to acquire the ability to understand, speak, read, and write
the language(s) of their choice; and 2) to develop a sound understanding
of the relevant cultures and literatures. The major in French, German,
oral Spanish consists of 30-32 hours of course work and will vary based
on students’ background in the language. The major in Chinese and
Japanese Studies requires a minimum of 35 credit hours. Individual
counseling and placement tests are provided by the department.

Course requirements are as follows:

• For students placed into the 200 level: 201-202 and eight courses at
  the 300 level taught in the target language, or six 300-level courses
  plus two related courses.

• For students placed into the 300-level: ten 300-level courses taught
  in the target language, or eight 300-level courses plus two related
  courses.

Related courses are those outside the department which are closely
related to Chinese, French, German, Japanese, and Spanish cultures, as
well as those departmental courses cross-listed with World Literature.

Additional Information for French Major

• Students who take both FRCH 311 and 312 may count only one of these
toward the major.

• At least two of the 300-level courses should be numbered above 320 and
taught in French.

The Department of Modern Languages and Literatures is committed to
helping students become informed and liberally educated citizens of the
world. Through the acquisition of language skills and cultural awareness,
our students prepare for careers that have an international dimension.
To that end, we strongly encourage them to spend their junior year abroad
in order to immerse themselves in a foreign culture and perfect their
language skills. We also run our own study abroad programs: two French
programs ("The Paris Experience" and "The Montreal Experience"), one
Spanish program ("The Cuban Experience"), one in Italy ("The Italian
Experience"), and one Arabic program ("The Arab World Experience–Jordan").

We work closely with other university departments and interdisciplinary
programs as well as with the cultural institutions of University Circle to
provide students with a broad understanding of the many opportunities...
Requirements for honors in modern languages and literatures are: 1) a GPA of at least 3.5 in the major, and 2) an honors thesis (FRCH, GRMN, JAPN, or SPAN 397 and 398, beyond the 30-32 hours required for the major) devoted to the investigation of a literary, linguistic, or cultural topic. The thesis is written in the target language, except in the case of Japanese Studies, which may permit papers in English. It must be read and approved by two readers and will be accepted for honors only if it achieves a grade of B or better. Students who qualify receive their degree “with Honors in Modern Languages and Literatures.” A registration form for students electing honors is available in the departmental office.

**Minors**

**Chinese, French, German, Italian, Japanese Studies, Russian, Spanish**

Course requirements for the minors are as follows:

- For students placed into the introductory level (no previous knowledge of the language): 101, 102, 201, 202, and one 300-level course (for the French minor, the 300-level course must be taught in the target language).

- For students placed into the 200 level or higher: five courses at the 200 and 300 levels.

Hebrew language courses may also count toward the minor in Judaic Studies.

**Graduate Programs**

The department offers the Master of Arts degree in French, and it is associated with the master’s degree program in world literature.

The standard MA in French requires 27-28 semester hours. An MA in French with a minor concentration in German, Japanese, or Spanish requires 36 hours. Full-time students are expected to complete the MA within two academic years.

The MA in world literature requires 27 hours.

**Department Faculty**

Cheryl Toman, PhD  
(University of Illinois, Urbana-Champaign)  
*Professor and Chair*

African and Middle Eastern Francophone literature, especially Cameroon; women’s writing; immigrant communities in France

Christine M. Cano, PhD  
(Yale University)  
*Associate Professor*

20th- and 21st-century French literature and culture

Denise Caterinacci, MA  
(Kent State University)  
*Senior Instructor*

Italian language and culture; language pedagogy; the role of motivation in language learning

M. Gabriela Copertari, PhD  
(Georgetown University)  
*Associate Professor*

Latin American literature and film, especially Argentinian; women’s writing; the modernista novel
Margaretmary Daley, PhD  
(Yale University)  
**Associate Professor**  
18th- and 19th-century German literature; German women writers; women's studies; feminist literary criticism

Gilbert Doho, PhD  
(Université Sorbonne Nouvelle-Paris 3)  
**Associate Professor**  
French drama; African Francophone theater and film; people theater and social movements; playwriting; African performing arts

Cristián G. Gómez Olivares, PhD  
(University of Iowa)  
**Assistant Professor**  
20th century Latin American narrative and poetry

Takao Hagiwara, PhD  
(University of British Columbia)  
**Associate Professor**  
Japanese literature, especially modern prose and poetry; classical and modern Japanese literature; pre-modern Japanese sensibilities and (post) modernism

Jutta Ittner, PhD  
(University of Hamburg)  
**Associate Professor**  
20th-century German literature; contemporary women writers; poetry; literary translation; German culture; representation of animals in contemporary literature

Marie Lathers, PhD  
(Brown University)  
**Elizabeth M. and William C. Treuhaft Professor of Humanities**  
Women and the visual arts; 19th-century French literature and the arts (painting, sculpture, photography, film); gender, science, and technology; feminist theory; space studies

Jacqueline C. Nanfito, PhD  
(University of California, Los Angeles)  
**Associate Professor**  
Colonial and 19th-century Latin American literature; Golden Age Hispanic literature; literary theory; Chicano literature; contemporary Latin American women writers

Damaris Punales-Alpizar, PhD  
(University of Iowa)  
**Associate Professor**  
20th-century Latin American literature; Latin American cinema; Cuban cinema; contemporary Cuban and Caribbean narrative; 19th- and 20th-century Latin American poetry; 20th-century peninsular literature

Yasuhiro Shirai, PhD  
(University of California-Los Angeles)  
**Eirik Borge Professor in Modern Languages**  
First and second language acquisition, applied linguistics, tense and aspect, Japanese linguistics

Susanne Vees-Gulani, PhD  
(University of Illinois, Urbana-Champaign)  
**Associate Professor**  
20th- and 21st-century literature and literary movements; German cultural studies; science and literature; medicine and literature; trauma studies; victim discourses; literary and cultural responses to World War II; German civil defense strategies in World War II

Peter Jianhua Yang, PhD  
(University of Utah)  
**Associate Professor**  
German literature, emphasis on 20th-century German literature; German theater; technology-enhanced language teaching; teaching pedagogy; business German; theatricality

Tatiana Zilotina, PhD  
(University of Virginia)  
**Instructor**  
19th- and 20th-century Russian literature; the poetry of Marina Tsvetaeva; women writers; Russian culture; Russian folklore

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**Lecturers**

Haydee Espino Castillo, MA  
(Kent State University)  
**Full-time Lecturer (Spanish)**

Man-Lih Chai, MA  
(University of Illinois, Urbana-Champaign)  
**Full-time Lecturer (Chinese)**

Elena Fernández, MA  
(Cleveland State University)  
**Full-time Lecturer (Spanish)**

Margaret M. Fitzgerald, MA  
(The Ohio State University)  
**Full-time Lecturer (Japanese)**

Ramez Islabouli, MA  
(Case Western Reserve University)  
**Full-time Lecturer (Arabic)**

Clara Lipszyc-Arroyo, MA  
(University of Western Ontario)  
**Full-time Lecturer (Portuguese and Spanish)**

Enno Lohmeyer, PhD  
(University of Kansas)  
**Full-time Lecturer (German)**

Alessandra Parry, MA  
(University of Akron)  
**Full-time Lecturer (Spanish)**

Fabienne Pizot-Haymore, MA  
(Université Paul Valéry, Montpellier III)  
**Full-time Lecturer (French)**

Charlotte Sanpere, PhD  
(Université Sorbonne Nouvelle-Paris 3)  
**Full-time Lecturer (French)**
Yuki Togawa, MA  
(Carnegie Mellon University)  
Full-time Lecturer (Japanese)

ARAB Courses

ARAB 101. Beginning Arabic I. 4 Units.  
The course introduces learners of Arabic to the sound and writing systems of this language and provides them with basic structural and lexical knowledge to enable them to say things in Arabic, such as greeting others, thanking someone, introducing oneself, describing one’s background, seeking and providing info and so forth. The ability to perform these language functions in real-life or lifelike situations is developed by engaging the learner in structured functional activities and grammatical exercises.

ARAB 102. Beginning Arabic II. 4 Units.  
ARAB 102 builds on the proficiency that students should have acquired in ARAB 101. The course follows a student-centered communicative approach in which class time is used in active learning through pair or group activities, role-play, games, selective listening and reading and other activities. The course emphasizes the four basic skills, reading, speaking, listening and writing. Students will be exposed to real audiovisual material in order to enhance comprehension and they will have to develop short oral and written responses about it. Aspects of culture across the Arab world will be included as an element of learning the language. Recommended preparation: ARAB 101

ARAB 201. Intermediate Arabic I. 4 Units.  
Intensive review of grammar and conversational skills in modern Arabic through readings, discussions and other activities that explore contemporary Arab life and culture. Recommended preparation: ARAB 102 or equivalent.

ARAB 202. Intermediate Arabic II. 4 Units.  
ARAB 202 is a continuation of ARAB 201 and will enable the students to develop advanced communicative skills for the use of Modern Arabic. It will focus on speaking, listening, reading and writing skills, and emphasize creative use of the language. Recommended preparation: ARAB 201 or equivalent.

ARAB 301. Advanced Arabic I. 3 Units.  
This is a higher level of Arabic study. The course objectives are to enhance the student’s language skills and to develop ability to use high-level Arabic effectively. It is designed to help students move from the intermediate level of proficiency, which centers on daily life and the immediate world, to the advanced, which broadens to include topics of general and professional interest. Recommended preparation: ARAB 202 or equivalent.

ARAB 337. Women in the Arab World. 3 Units.  
The purpose of this course is twofold: It is a course that allows students an in-depth look at the diverse women who represent a number of cultures in the Arab world in nations from the Mashrek to the Maghreb. The second primary goal of the course is to study such women through the eyes of leading Arab women theorists who have made an impact not only in their own countries, but also on disciplines intersecting with women’s studies worldwide. We will study the Arab woman’s place in her respective society, in political and economic systems, in education, and in the family. We will also analyze her contributions to art and literature as well as to the sciences. The course will provide an overview of the Arab woman throughout history, from her origins to her place within recent movements within the Arab Spring and other current world events. As Arab women are Muslim, Christian, and Jewish, views of women within these major world religions will also be taken into account as we study the Arab woman as well as religion’s impact on culture in the Middle East and in the Maghreb in particular. In the course, we will utilize theoretical texts, but also case studies as well as examples from media and the arts. During the semester, we will take advantage of teleconferencing opportunities between CWCU and two major academic units for Women’s Studies in the Arab world: The Institute for Women’s Studies in the Arab World (IWSAW) in Beirut, Lebanon, and the University of Jordan’s Center for Women’s Studies in Amman. Offered as FRCH 337, FRCH 437, ARAB 337, ETHS 337 and WGST 337. Counts for CAS Global & Cultural Diversity Requirement.

ARAB 349. The Arab World Experience. 3 Units.  
Taught and led by Case faculty, The Arab World Experience is a spring semester course with a spring break study abroad component in a Middle Eastern or North African country supplemented by course meetings before and after travel. It will rotate among countries such as Jordan, Lebanon, Morocco, etc. and be taught by faculty with appropriate area expertise in Arabic, Women’s and Gender Studies, and/or Ethnic Studies. The course focuses on topics such as history, politics, culture, and gender relations within the society of study. Workload and learning outcomes are commensurate with a semester-long three credit hour course. Guest lectures in the host country are an important component of the course as they bring a fresh, authentic perspective to the aforementioned topics discussed. There will be three three-hour meetings prior to travel, required reading, and one three-hour meeting after travel. In the host country, students will spend seven days (five-eight hours per day) in seminars, discussions, and site visits. Student grades are determined on the basis of participation, attendance, a daily experiential learning journal, interviews with guest speakers, and a final exam. Offered as ARAB 349, ETHS 349 and WGST 349. Counts for CAS Global & Cultural Diversity Requirement.

ARAB 399. Independent Study in Arabic. 1 - 3 Units.  
Topics will be constructed to fit the interest of a student who has already taken an advanced course in Arabic. Prereq: ARAB 301.

CHIN Courses

CHIN 101. Elementary Chinese I. 4 Units.  
Introductory course in speaking, understanding, reading and writing Chinese. Students are expected to achieve control of the sound system and basic sentence patterns of standard Mandarin Chinese. The course emphasizes speaking and aural comprehension.

CHIN 102. Elementary Chinese II. 4 Units.  
Continuation of CHIN 101. Recommended preparation: Consent of department.
CHIN 201. Intermediate Chinese I. 4 Units.
Emphasizes basic structures of standard Mandarin Chinese; helps students improve reading, writing, listening and speaking abilities. Chinese culture, society, and people introduced through supplementary materials and activities. Recommended preparation: CHIN 102 or equivalent.

CHIN 202. Intermediate Chinese II. 4 Units.
Continuation of CHIN 201. Students must use course material offered by the Online Language Learning Center in addition to class meetings. Recommended preparation: CHIN 201.

CHIN 203. Intermediate Chinese III. 4 Units.
As the continuation of CHIN 202, CHIN 203 is the third course at the intermediate level in Chinese language at CWRU. In this course, students focus on conversation combined with further study of grammatical and syntactic rules, and of cultural elements. The objective is a further development of communicative skills in listening, speaking, reading, and writing. Upon completion of this course, students' proficiency will be optimal for entering CHIN 301. The course is a 4 credit course. The course uses integrated Chinese Level 2, Part 1, from the same series of textbooks for CHIN 201 and 202. The course covers 7 lessons of the book, two weeks for each lesson, in average. Students are expected to preview each lesson before class, to complete the assigned homework, and to study after class the content covered that day. The final grade will be based on the mid-term and final exams, and on quizzes. There will be a quiz at the end of each lesson. Chinese word-processing ability is one of the objectives of this course. Students will learn how to type Chinese texts using the Pinyin input method. Prereq: CHIN 202, or two years of study, or requisites not met permission.

CHIN 240. Modern Chinese Literature in Translation. 3 Units.
This course examines Modern Chinese Literature from the beginning of the 20th century to contemporary period in the contexts of Chinese historical and cultural transformations. It examines representative works of the major literary genres, including fiction, poetry, drama, and prose writing. We will be making the following inquiries: What is modern Chinese literature? What does it tell us about the cultural, social, psychological, and historical changes that occurred in modern China? Who are the main literary and cultural figures, and what did they contribute to the construction of the Chinese nation? How did Western thoughts impact on the ways in which Chinese reflected on their own cultural identities and social and gender relationships? This course is taught in English. Offered as CHIN 240, ASIA 240 and WLIT 240. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 250. Classical Chinese Literature in Translation. 3 Units.
This course is a survey of the classical Chinese literature from the pre-Qin Period to the fall of Qing Dynasty in 1911. Students will be introduced to a variety of forms and genres, including classical poetry, lyric, aria, elegy, rhapsody, folk song, narrative verse, parallel prose, classical-language short story, vernacular short story, novel, drama, etc. This course is taught in English. Offered as CHIN 250, ASIA 250 and WLIT 250. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 253. Introducing Chinese Religions. 3 Units.
This "topics" course offers an introduction to the academic study of Chinese religions. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and a basic religious literacy in the nuances and complexities in Chinese religions within various historical and socio-cultural contexts. Section topics might include, but are not limited to: Confucianism, Daoism, Chinese Buddhism, Gender and Sexuality in Chinese Religions. Students may repeat the course for credit once (two times total for 6 credits), provided that the two sections are different. Offered as RLGN 153, ETHS 153 and CHIN 253. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 301. Advanced Chinese I. 4 Units.
Students work to achieve fluency in listening, speaking, reading and writing. Students must attend Language Resource Center in addition to class meetings. Recommended preparation: CHIN 202 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 302. Advanced Chinese II. 4 Units.
Continuation of CHIN 301. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 307. Body, Health and Medicine in Chinese Religions: Historical and Contemporary Perspectives. 3 Units.
This course critically evaluates the history and development of traditional Chinese approaches to health and medicine in the context of Chinese religious, philosophical, and socio-cultural history. It examines the constructions of the body in Chinese religious and philosophical thought across different historical periods and evaluates their significance and implications for understanding Chinese approaches to health and medicine. It discusses the conceptions of "health" and "good health" in ancient China, the distinction between "healing" and "curing," the development of the complementary yin-yang and five phases (wuxing) theories, understandings of nature (xing) and body (ti), the concept of qi as life force, and various microcosm-macrocosm analogies that emerged from Chinese religious and philosophical traditions. It explores how these religious and philosophical frameworks, beginning with the Daoist classic, Basic Questions in the Inner Classic of the Yellow Emperor (Huangdi Neijing Suwen) have evolved to undergird the development of diet, acupuncture, moxibustion, meditation, and various alchemical practices within Chinese holistic conceptions of health and practices of Traditional Chinese Medicine. Offered as RLGN 307, RLGN 407, CHIN 307, HSTY 308, and ETHS 307. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 315. Business Chinese. 3 Units.
The Business Chinese course is designed to enhance students' listening, speaking, reading, and writing skills in Chinese through a variety of activities. It will focus on China's contemporary international business issues and practices. At the end of the semester, the students will have a basic knowledge of China's socio-cultural values, trade policy, and role in the world economy after its entry into the WTO and the ability to hold conversations on selected business topics with correct business vocabulary and in a culturally appropriate manner; to read business-related materials; and to write basic business communications including letters, reports and resumes. It is taught in Chinese and English. Offered as CHIN 315 and CHIN 415. Counts for CAS Global & Cultural Diversity Requirement. Prereq: CHIN 202 or equivalent.
CHIN 316. Christianity in China. 3 Units.
This course critically evaluates Christianity's long history in China, beginning with the "Luminous Religion" (Jingjiao) that was propagated by Assyrian Christian missionaries in Tang China (7th century CE), the missionary endeavors of Catholic and Protestant foreign missionaries and mission societies, the rise of indigenous Chinese Christianities that sought independence from foreign missionaries, the impact of communist rule and the Cultural Revolution, and current developments involving both the official government-approved churches (i.e., the Three Self Patriotic Movement and the Chinese Patriotic Catholic Association) on the one hand, and the house church movement (jiating jiaohui) on the other hand. Students will critically discuss and analyze the historical dimensions of Christianity's presence in China and engagement with various social, cultural, political, philosophical, and religious aspects of Chinese society, past and present, and consider the implications of emergent forms of contemporary indigenous Chinese Christian movements for the future of Chinese Christianity. Offered as RLGN 316, CHIN 316 and ASIA 330. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 320. Chinese Popular Culture. 3 Units.
In this course we are going to study Chinese (including Mainland China, Hong Kong, Taiwan, and Chinese Diaspora) popular culture since the 1980s. By examining different forms of popular culture, including popular literature, film, music, TV programs, posters, the Internet, etc., we will be looking into their political, ideological, sociological, cultural, and psychological mechanisms. The film viewing will take place outside the class. Offered as: CHIN 320, ASIA 320 and WLIT 320. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 330. Chinese Cinema. 3 Units.
This course is an exploration to the history of and critical issues in Chinese cinema: we will discuss early film making in Shanghai, leftist melodrama, Socialist films, the Chinese New Wave, underground films, the film making in the era of globalization, and etc. Themes and genres that will be investigated include melodrama, the "Fifth Generation", underground film making, filmic representations of women, minority films, and historical epics. Films from mainland China, Hong Kong, Taiwan, and diasporic communities will be discussed to illuminate what it means to be "Chinese." All of the films in this course come with English subtitles; the film viewing will take place outside the class. Offered as CHIN 330 and ASIA 330. Counts for CAS Global & Cultural Diversity Requirement.

CHIN 380. Contemporary Chinese Texts I. 3 Units.
This course is designed for students who have completed CHIN 302 or equivalent. It provides intensive trainings in communicational skills by reading, watching, and discussing a variety of texts. Counts for CAS Global & Cultural Diversity Requirement. Prereq: CHIN 302 or equivalent.

CHIN 381. Contemporary Chinese Texts II. 3 Units.
This course is designed for students who have completed CHIN 380 or equivalent. It provides intensive training in communication skills by reading, watching, and discussing a variety of texts. Counts for CAS Global & Cultural Diversity Requirement. Prereq: CHIN 380.

CHIN 399. Independent Study. 1 - 3 Units.
Directed study for those students who have progressed beyond available course offerings and want to continue study of Chinese language, Chinese culture, Chinese literature, or other Chinese Studies topics in Chinese. Counts for CAS Global & Cultural Diversity Requirement. Prereq: CHIN 302.

CHIN 415. Business Chinese. 3 Units.
The Business Chinese course is designed to enhance students' listening, speaking, reading, and writing skills in Chinese through a variety of activities. It will focus on China's contemporary international business issues and practices. At the end of the semester, the students will have a basic knowledge of China's socio-cultural values, trade policy, and role in the world economy after its entry into the WTO and the ability to hold conversations on selected business topics with correct business vocabulary and in a culturally appropriate manner; to read business-related materials; and to write basic business communications including letters, reports and resumes. It is taught in Chinese and English. Offered as CHIN 315 and CHIN 415. Counts for CAS Global & Cultural Diversity Requirement. Prereq: CHIN 202 or equivalent.

FRCH Courses

FRCH 101. Elementary French I. 4 Units.
Emphasizes conversational skills. Students are expected to achieve control of sound system and basic sentence structures of French. Students must complete assignments at the Online Language Learning Center in addition to attending scheduled class meetings.

FRCH 102. Intermediate French I. 4 Units.

FRCH 201. Intermediate French I. 4 Units.
Intensive review of grammar and usage through readings, discussions and other activities that emphasize contemporary French life. Students must complete assignments at the Online Language Learning Center in addition to attending scheduled class meetings. Recommended preparation: FRCH 102 or equivalent.

FRCH 202. Intermediate French II. 4 Units.
A continuation of FRCH 201, the course focuses on the acquisition of intermediate-level skills in language and culture. Students must complete assignments at the Online Language Learning Center in addition to attending scheduled class meetings. Recommended preparation: FRCH 201 or equivalent.

FRCH 208. The Montreal Experience. 1 Unit.
One-week immersion learning experience performing community service in Montreal, Canada. Students meet several times for orientation before spending spring break in French-speaking Montreal. Community service may include volunteering in a homeless center, a hospital, or school. Application available from Department office. This course may be repeated once. Permit required. Prereq or Coreq: FRCH 202 or equivalent.

FRCH 295. The Francophone World. 3 Units.
The course offers an introduction to the Francophone World from a historical, cultural, and literary perspective. The Francophone World includes countries and regions around the globe with a substantial French-speaking population (and where French is sometimes, but not always, an official language): North America (Louisiana, Quebec, and Acadia); North Africa (Tunisia, Morocco, Algeria, and Egypt); the Middle East (Lebanon, Syria); the Caribbean (Martinique, Guadeloupe, Haiti); Southeast Asia (Vietnam); and Europe (France, Belgium, Switzerland, and Luxembourg). FRCH 295 provides a comprehensive overview of the Francophone World, while focusing on a particular area or areas in any given semester. Offered as ETHS 295, FRCH 295, and WLIT 295.
FRCH 308. The Paris Experience. 3 Units.
Three-week immersion learning experience living and studying in Paris. The focus of the course is the literature and culture of the African, Arab, and Asian communities of Paris. Students spend a minimum of fifteen hours per week visiting cultural centers and museums and interviewing authors and students about the immigrant experience. Assigned readings complement course activities. Students enrolled in FRCH 308/408 do coursework in French. WLIT 308/408 students have the option of completing coursework in English. Graduate students have additional course requirements. Offered as FRCH 308, WLIT 308, FRCH 408, and WLIT 408. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202.

FRCH 310. Advanced Composition and Reading. 3 Units.
An initiation to the literature of Francophone expression with a focus on close reading. Texts may include short stories, essays, and novels. Students engage in the discussion of their readings and learn how to express their ideas both orally and in written form. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202 or equivalent.

FRCH 311. Advanced Conversation I. 3 Units.
Designed to enhance pronunciation, speaking and listening Comprehension through the discussion of French literature and media for children. Required for Teacher Licensure candidates. Prereq: FRCH 202 or equivalent.

FRCH 312. Advanced Conversation II. 3 Units.
A functional approach to conversation. Students work to develop fluency in spoken French using current colloquial vocabulary and focusing on current issues. Practice in using speech appropriate to a variety of situations, including public debates. Prereq: FRCH 202 or equivalent.

FRCH 313. Medical French. 3 Units.
Medical French is an upper-level course with a focus on health care in France and other Francophone countries. Students gain knowledge of the health care structures of various Francophone countries, as well as the vocabulary used in professional medical communication. Special emphasis on Doctors without Borders (Medecins sans frontieres). There will be visits to local hospitals and health care sites. Press articles, media reports, films, videos, and short literary texts are used as resources. Offered as FRCH 313 and FRCH 413. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202 or equivalent.

FRCH 314. Translation Techniques. 3 Units.
Contrastive grammar analysis and stylistics are used to foster linguistic awareness and to introduce students to the methods and skills of translation. Recommended preparation: FRCH 310. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202.

FRCH 315. Business French. 3 Units.
Business French is an upper-level course with a focus on the economic life of France and other Francophone countries. Students gain knowledge of the economic structures and the business organization of Francophone countries as they enhance the linguistic skills used in professional communication. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202 or equivalent.

FRCH 316. Contemporary France. 3 Units.
A study of contemporary France, this course features discussions and lectures on a variety of topics (geography, political and social life, contemporary culture) to develop factual knowledge about France and a sound understanding of current issues as presented in the media. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202 or equivalent.

FRCH 317. French Cinema. 3 Units.

FRCH 318. The Origins of France. 3 Units.
Examination through texts, films, and other media of major historical, intellectual, and artistic influences that have shaped the evolution of French civilization. Students will attempt to identify the values and myths that have contributed to the ongoing formation of modern France. Recommended preparation: FRCH 310. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202.

FRCH 319. Modern France. 3 Units.

FRCH 320. Introduction to French Literature. 3 Units.
Taught in French. An introduction to literary analysis through the study of important works of French literature. Written assignments are designed to develop skills in close reading, to introduce students to literary terminology in French, and to develop a capacity for clear, precise communication of an argument. Classes are discussion-based. Recommended preparation: FRCH 310. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202 or equivalent.

FRCH 321. Twelfth to Sixteenth-Century French Literature. 3 Units.
Medieval and Renaissance literature, from the chanson de geste and the roman courtois to Rabelais and Montaigne. Authors, works and topics may vary. May be offered on both Medieval and Renaissance, or on either. May be repeated if time period is different. Maximum 6 credits. Offered as: FRCH 321 and FRCH 421. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202. Coreq: FRCH 320.

FRCH 335. Women in Developing Countries. 3 Units.
This course will feature case studies, theory, and literature of current issues concerning women in developing countries primarily of the French-speaking world. Discussion and research topics include matriarchal traditions and FGM in Africa, the Tunisian feminist movement, women, Islam, and tradition in the Middle East, women-centered power structures in India (Kerala, Pondichery), and poverty and women in Vietnam, Laos, and Cambodia. Guest speakers and special projects are important elements of the course. Seminar-style format, taught in English, with significant disciplinary writing in English for WGST, ETHES, and some WLIT students, and writing in French for FRCH and WLIT students. Writing assignments include two shorter essays and a substantial research paper. Offered as ETHES 335, FRCH 335, WLIT 335, WGST 335, FRCH 435 and WLIT 435. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.
FRCH 337. Women in the Arab World. 3 Units.
The purpose of this course is twofold: it is a course that allows students an in-depth look at the diverse women who represent a number of cultures in the Arab world in nations from the Mashrek to the Maghreb. The second primary goal of the course is to study such women through the eyes of leading Arab women theorists who have made an impact not only in their own countries, but also on disciplines intersecting with women's studies worldwide. We will study the Arab woman's place in her respective society, in political and economic systems, in education, and in the family. We will also analyze her contributions to art and literature as well as to the sciences. The course will provide an overview of the Arab woman throughout history, from her origins to her place within recent movements within the Arab Spring and other current world events. As Arab women are Muslim, Christian, and Jewish, views of women within these major world religions will also be taken into account as we study the Arab woman as well as religion's impact on culture in the Middle East and in the Maghreb in particular. In the course, we will utilize theoretical texts, but also case studies as well as examples from media and the arts. During the semester, we will take advantage of teleconferencing opportunities between CWRU and two major academic units for Women's Studies in the Arab world: The Institute for Women's Studies in the Arab World (IWSAW) in Beirut, Lebanon, and the University of Jordan's Center for Women's Studies in Amman. Offered as FRCH 337, FRCH 437, ARAB 337, ETHS 337 and WGST 337. Counts for CAS Global & Cultural Diversity Requirement.

FRCH 338. The Cameroon Experience. 3 Units.
Three-week immersion learning experience living and studying in Cameroon. The focus of the course is the culture, literature, and language of Francophone Cameroon, with some emphasis on Anglophone Cameroon. Students spend a minimum of fifteen hours per week visiting cultural sites and attending arranged courses at the University of Buea. Students will prepare a research paper. Coursework is in French. To do coursework in English, students should enroll in WLIT 338/438 or ETHS 338/438. Offered as ETHS 338, FRCH 338, WLIT 338, ETHS 438, FRCH 438, and WLIT 438. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 202.

FRCH 351. Nineteenth-Century French Literature. 3 Units.
Romanticism, realism, and naturalism in the novel and the dramatic tradition. Authors, works, and topics may vary. Offered as FRCH 351 and FRCH 451. Counts for CAS Global & Cultural Diversity Requirement. Prereq or Coreq: FRCH 320.

FRCH 372. Topics in French Drama. 3 Units.
A topical approach to issues and problems specific to drama. Plays, playwrights, aesthetic theories, and historical periods studied in this course may vary. Offered as FRCH 372 and FRCH 472. Counts for CAS Global & Cultural Diversity Requirement. Prereq or Coreq: FRCH 320.

FRCH 373. The Novel and the Novella. 3 Units.
A study of narrative fiction focused on either a particular genre (the novel, the short story) or a particular type of novel (psychological novel, realist novel, detective novel), tale (the fantastic tale, the fairy tale), or novella. Offered as FRCH 373 and FRCH 473. Prereq or Coreq: FRCH 320.

FRCH 374. Major Writers and Literary Movements. 3 Units.
In-depth study of the work of a major writer, film director, or intellectual figure; or of a significant literary, intellectual, or artistic movement. Approaches, content, and instructor will vary. Offered as FRCH 374 and FRCH 474. Counts for CAS Global & Cultural Diversity Requirement. Prereq: FRCH 320.

FRCH 375. Francophone Literature. 3 Units.
An examination of Francophone literature focused on the problematics of identity within the colonial and post-colonial context. Writers and works may vary. Offered as FRCH 375 and FRCH 475. Counts for CAS Global & Cultural Diversity Requirement. Prereq or Coreq: FRCH 320.

FRCH 377. Special Topics. 3 Units.
The special topics course is designed to provide a forum for specific themes or subjects not otherwise covered in the curriculum. Approaches and content will vary. Maximum 6 credits. Offered as FRCH 377 and FRCH 477. Counts for CAS Global & Cultural Diversity Requirement. Prereq or Coreq: FRCH 320.

FRCH 396. Senior Capstone - French. 3 Units.
The Senior Capstone in French in an independent study project chosen in consultation with a capstone advisor. The capstone project should reflect both the student's interest within French and/or Francophone Studies and the courses he or she has taken to fulfill the major. The project requires independent research using an approved bibliography and plan of action. In addition to written research, the student will also present the capstone project in a public forum that is agreed upon by the project advisor and the student. Counts as SAGES Senior Capstone. Prereq: Senior status required. Major in French or Francophone Studies required.

FRCH 397. Honors Thesis I. 3 Units.
Intensive study of a literary, linguistic, or cultural topic with a faculty member, leading to the writing of a research paper in French. Limited to senior majors. Permit required.

FRCH 398. Honors Thesis II. 3 Units.
Continuation of FRCH 397. Limited to senior majors. Permit required. Prereq: FRCH 397.

FRCH 399. Independent Study. 1 - 3 Units.
The course is for students who have special interests and commitments that are not addressed in regular courses, and who wish to work independently.

FRCH 408. The Paris Experience. 3 Units.
Three-week immersion learning experience living and studying in Paris. The focus of the course is the literature and culture of the African, Arab, and Asian communities of Paris. Students spend a minimum of fifteen hours per week visiting cultural centers and museums and interviewing authors and students about the immigrant experience. Assigned readings complement course activities. Students enrolled in FRCH 308/408 do coursework in French. WLIT 308/408 students have the option of completing coursework in English. Graduate students have additional course requirements. Offered as FRCH 308, WLIT 308, FRCH 408, and WLIT 408. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

FRCH 413. Medical French. 3 Units.
Medical French is an upper-level course with a focus on health care in France and other Francophone countries. Students gain knowledge of the health care structures of various Francophone countries, as well as the vocabulary used in professional medical communication. Special emphasis on Doctors without Borders (Medecins sans frontieres). There will be visits to local hospitals and health care sites. Press articles, media reports, films, videos, and short literary texts are used as resources. Offered as FRCH 313 and FRCH 413. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate Standing.
FRCH 421. Twelfth to Sixteenth-Century French Literature. 3 Units.
Medieval and Renaissance literature, from the chanson de geste and the
romancourtis to Rabelais and Montaigne. Authors, works and topics
may vary. May be offered on both Medieval and Renaissance, or on either.
May be repeated if time period is different. Maximum 6 credits. Offered
as: FRCH 321 and FRCH 421. Counts for CAS Global & Cultural Diversity
Requirement. Prereq: Graduate Standing.

FRCH 435. Women in Developing Countries. 3 Units.
This course will feature case studies, theory, and literature of current
issues concerning women in developing countries primarily of the French-
speaking world. Discussion and research topics include matriarchal
traditions and FGM in Africa, the Tunisian feminist movement, women,
Islam, and tradition in the Middle East, women-centered power structures
in India (Kerala, Pondichery), and poverty and women in Vietnam, Laos,
and Cambodia. Guest speakers and special projects are important
elements of the course. Seminar-style format, taught in English, with
significant disciplinary writing in English for WGST, ETHS, and some WLIT
students, and writing in French for FRCH and WLIT students. Writing
assignments include two shorter essays and a substantial research paper. Offered as ETHS 335, FRCH 335, WLIT 335, WGST 335, FRCH 435
and WLIT 435. Counts as SAGES Departmental Seminar. Counts for CAS
Global & Cultural Diversity Requirement.

FRCH 437. Women in the Arab World. 3 Units.
The purpose of this course is twofold: It is a course that allows students
an in-depth look at the diverse women who represent a number of
cultures in the Arab world in nations from the Mashrek to the Maghreb.
The second primary goal of the course is to study such women through
the eyes of leading Arab women theorists who have made an impact
not only on their own countries, but also on disciplines intersecting with
women’s studies worldwide. We will study the Arab woman’s place in her
respective society, in political and economic systems, in education, and in
the family. We will also analyze her contributions to art and literature as
well as to the sciences. The course will provide an overview of the Arab
woman throughout history, from her origins to her place within recent
movements within the Arab Spring and other current world events. As
Arab women are Muslim, Christian, and Jewish, views of women within
these major world religions will also be taken into account as we study
the Arab woman as well as religion’s impact on culture in the Middle East
and in the Maghreb in particular. In the course, we will utilize theoretical
texts, but also case studies as well as examples from media and the
arts. During the semester, we will take advantage of teleconferencing
opportunities between CWRU and two major academic units for Women’s
Studies in the Arab world: The Institute for Women’s Studies in the
Arab World (IWSAW) in Beirut, Lebanon, and the University of Jordan’s
Center for Women’s Studies in Amman. Offered as FRCH 337, FRCH 437,
ARAB 337, ETHS 337 and WGST 337. Counts for CAS Global & Cultural
Diversity Requirement.

FRCH 438. The Cameroon Experience. 3 Units.
Three-week immersion learning experience living and studying in
Cameroon. The focus of the course is the culture, literature, and language
of Francophone Cameroon, with some emphasis on Anglophone
Cameroon. Students spend a minimum of fifteen hours per week visiting
cultural sites and attending arranged courses at the University of Buea.
Students will prepare a research paper. Coursework is in French. To
do coursework in English, students should enroll in WLIT 338/438 or
ETHS 338/438. Offered as ETHS 338, FRCH 338, WLIT 338, ETHS 438,
FRCH 438, and WLIT 438. Counts for CAS Global & Cultural Diversity
Requirement.

FRCH 451. Nineteenth-Century French Literature. 3 Units.
Romanticism, realism, and naturalism in the novel and the dramatic
tradition. Authors, works, and topics may vary. Offered as FRCH 351 and

FRCH 461. Twentieth-Century French Literature. 3 Units.
A study of representative novelists (e.g., Proust, Gide, Colette, Sartre,
Beauvoir) and playwrights (e.g., Claudel, Beckett, Genet) in historical
context. Authors, works, and topics may vary. Offered as FRCH 361 and
FRCH 461.

FRCH 472. Topics in French Drama. 3 Units.
A topical approach to issues and problems specific to drama. Plays,
playwrights, aesthetic theories, and historical periods studied in this
course may vary. Offered as FRCH 372 and FRCH 472. Counts for CAS
Global & Cultural Diversity Requirement.

FRCH 473. The Novel and the Novella. 3 Units.
A study of narrative fiction focused on either a particular genre (the novel,
the short story) or a particular type of novel (psychological novel, realist
novel, detective novel), tale (the fantastic tale, the fairytale), or novella.
Offered as FRCH 373 and FRCH 473.

FRCH 474. Major Writers and Literary Movements. 3 Units.
In-depth study of the work of a major writer, film director, or intellectual
figure; or of a significant literary, intellectual, or artistic movement.
Approaches, content, and instructor will vary. Offered as FRCH 374 and
Prereq: Graduate standing.

FRCH 475. Francophone Literature. 3 Units.
An examination of Francophone literature focused on the problematics
of identity within the colonial and post-colonial context. Writers and works
may vary. Offered as FRCH 375 and FRCH 475. Counts for CAS Global &
Cultural Diversity Requirement.

FRCH 477. Special Topics. 3 Units.
The special topics course is designed to provide a forum for specific
themes or subjects not otherwise covered in the curriculum. Approaches
and content will vary. Maximum 6 credits. Offered as FRCH 377 and

FRCH 590. Seminar: Topics in Modern Literature and Culture. 3 Units.
French literature and culture since the Revolution of 1789. Topics vary
depending on student and instructor interests; may include realism
and naturalism, Proust, contemporary film, or French philosophy. Maximum 9
credits. Prereq: Graduate standing.

FRCH 595. Independent Research. 1 - 3 Units.
Graded independent work on a literary topic arranged individually with the
instructor. Prereq: Graduate standing.

FRCH 601. Independent Study. 1 - 18 Units.
For individual students or larger groups with special interests.

FRCH 651. Thesis M.A.. 6 - 9 Units.
Thesis M.A. serves the graduate plan A of the Graduate Handbook.

GRMN Courses

GRMN 101. Elementary German I. 4 Units.
Introductory course emphasizing conversational skills. Students achieve
control of the sound system and basic sentence structures of spoken and
written German. Students must use the course material offered by the
Online Language Learning Center in addition to class meetings.

GRMN 102. Elementary German II. 4 Units.
Continuation of GRMN 101, emphasizing conversational skills. Prereq:
GRMN 101 or equivalent.
GRMN 201. Intermediate German I. 4 Units.
Emphasizes both language and culture and is taught in German. Review of grammar and usage of German while studying texts and videotapes which focus on contemporary life in Germany. Prereq: GRMN 102 or equivalent.

GRMN 202. Intermediate German II. 4 Units.
Continuation of GRMN 201; conducted in German. Study of texts and videotapes which focus on contemporary life in Germany. Prereq: GRMN 201 or equivalent.

GRMN 303. German Culture & Civilization. 3 Units.
Examines aspects of contemporary Germany, including political and social systems and cultural life through seminar discussions of texts, films, and other media. Along with oral presentations and essay tests, students must select a research topic of interest to the discipline and write an analytic essay in German on the topic. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: GRMN 202.

GRMN 308. The Munich Experience: Spring Course/Summer Study Advanced Level. 3 Units.
A semester seminar class, conducted in German, which culminates with a three-week immersion learning experience spent living and studying in Munich. Students reside with German families, study German daily in a formal setting, and practice comprehension, speaking, reading, and writing. Regular visits to museums, galleries, and cultural events; firsthand observation of history, life, and architecture of a major cultural center; day trips to cultural phenomena and events in the German countryside. Counts for CAS Global & Cultural Diversity Requirement. Prereq or Coreq: GRMN 202 or equivalent.

GRMN 310. Advanced German Reading and Composition. 3 Units.
An advanced-level skills course focusing on reading and writing for students who have already studied intermediate German. Develops abilities to read authentic, unabridged texts, such as contemporary newspaper and magazine articles; readings increase progressively in length and vary in genre. Also practices composition skills by composing academic prose such as objective summaries, reviews, precis, letters, short creative texts, and analytic written forms such as short essays to produce increasingly sophisticated analytical compositions in German. Includes instruction on use of English- and German-language research tools, German-German dictionaries, and study guides. Taught in German. Counts as SAGES Departmental Seminar. Prereq: GRMN 202 or equivalent.

GRMN 311. Advanced Conversation. 3 Units.
Students work to improve fluency in spoken German. Topics include contemporary issues; current vocabulary is stressed. Students practice using speech appropriate to various situations. Prereq: GRMN 202 or equivalent.

GRMN 312. German Proficiency Through Drama. 3 Units.
Readings begin with single scenes and progress to full length radio plays and theater plays which gradually increase in linguistic difficulty and complexity of central themes. Introduction to the elements of drama such as dialogue, character and dramatic structure, as well as the genres of tragedy, comedy, and tragicomedy. Focus: effective communication of critical, interpretative, and analytic ideas in discussion and in writing. Counts as SAGES Departmental Seminar. Prereq: GRMN 202 or equivalent.

GRMN 313. Intro to German Literature. 3 Units.
Introduction to German literature and the cultural issues it addresses. Readings include the main literary and folk genres (short texts or excerpts), gradually increasing in linguistic difficulty and complexity of central themes. They cover the major literary periods from the 18th to the 21st centuries. Focus: effective communication of critical, interpretative, and analytic ideas in discussion and in writing. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: GRMN 202 or equivalent.

GRMN 315. Business German. 3 Units.
This course is taught in German. It is designed to enhance students' German listening, speaking, reading, and writing skills through a variety of activities. It also aims at developing students' cross-cultural awareness and communicative competence in the specialized field of German for Business and Economics in an increasingly global workplace. The course will explore German demography and economic geography; the European Union, the Euro, and Germany's role in this union; German economic systems, industries, banking systems, advertising and sales, transportation and tourism; Germany's corporate culture, industrial relations, codetermination in German companies, etc. Counts for CAS Global & Cultural Diversity Requirement. Prereq: GRMN 202 or equivalent.

GRMN 320. Topics in Narrative. 3 Units.
This course examines representative prose works (tales, novellas, short novels, letters, and essays) chosen to present reactions and impressions to social and aesthetic conditions in German-speaking countries and to introduce students to different styles and varieties of German prose. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.

GRMN 326. Witches, Weddings, and Wolves. 3 Units.
Intensive study of German Folk Tales as collected and altered by the Brothers Grimm. The Maerchen as both children's and adult literature. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.

GRMN 330. Topics in German Cinema. 3 Units.
Overview of German Cinema from the beginning to the present. Film selection representative of major directors, major periods (such as expressionism or The New German Cinema), particular themes from different historical perspectives, and literature in film. All films are in German. Taught in German. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.

GRMN 340. Topics in German Drama. 3 Units.
Overview of German drama from the beginning to the present. Explores German plays by applying different disciplinary approaches such as historical, cultural, and literary analyses. All plays are in German. Taught in German. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.

GRMN 360. Topics in Major German Authors. 3 Units.
Concentrates on a specific author or small group of authors within an aesthetic or historical context, for example: Goethe, Heine, Bachmann, Junges Deutschland, or die Gruppe 47. Examines the breadth of themes and styles and may include literary, philosophical, biographical, and other kinds of texts. Readings and discussions in German. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.
GRMN 365. German Literature in Translation. 3 Units.
Goethe defined "World Literature" (Weltliteratur) as "Intellectual Trade Relations" (geistiger Handelsverkehr). This course gives students the opportunity to study German literary works in translation and thus to trade intellectual relations with a literary culture previously unknown to them. Counts toward the German major only as a related course. No knowledge of German required. Offered as GRMN 365 and WLIT 365.

GRMN 367. German Classicism/Romanticism. 3 Units.
Selected works of Goethe, Schiller, Hoelderlin, von Kleist, and others. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.

GRMN 370. Topics in Literary Periods. 3 Units.
Overview of German literary periods from the beginning to the present. Explores German literary works in all three major genres from the historical, social, and literary perspectives. All works are in German. Taught in German. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.

GRMN 380. Topics in Advanced German Culture Studies. 3 Units.
Exploration of the culture of the arts, political culture, and the cultural self-expression of the German-speaking countries from their beginnings to the present. Focus: The cultural changes within certain historical periods. Examination of particular aspects such as culture as mass deception in fascist Germany and the GDR, the reflection of contemporary culture in literature and cinema, problems of cultural identity and multiculturalism, and the role of postmodern culture industry and the critical discourse today. Taught in German. Counts for CAS Global & Cultural Diversity Requirement. Prereq: One 300-level GRMN course.

GRMN 395. Special Topics in German Literature. 3 Units.
An advanced seminar on German literature with a specific focus that transcends author, period or genre, probably but not limited to theme or motif, such as "Faust and Monsters." Counts toward the German major only as a related course. No knowledge of German required. Offered as GRMN 395 and WLIT 395.

GRMN 397. Honors Thesis I. 3 Units.
Intensive study of a literary, linguistic, or cultural topic with a faculty member, leading to the writing of a research paper in German. Limited to senior majors. Permit required. Prereq: One 300-level GRMN course.

GRMN 398. Honors Thesis II. 3 Units.
Continuation of GRMN 397. Limited to senior majors. Permit required. Prereq: GRMN 397.

GRMN 399. Independent Study in German. 1 - 3 Units.
For majors and advanced students under special circumstances. Permit required.

HBRW Courses

HBRW 101. Elementary Modern Hebrew I. 4 Units.
The course objective is to enable students to develop basic communicative skills in standard Modern Hebrew. Students will become acquainted with the Hebrew alphabet and vowels, and with basic grammar and vocabulary.

HBRW 102. Elementary Modern Hebrew II. 4 Units.
The course objective is to continue to develop the students' basic communicative skills in standard Modern Hebrew. Students will be introduced to more complex grammatical constructs, linguistic forms and vocabulary. Prereq: HBRW 101 or consent of department.

HBRW 201. Intermediate Modern Hebrew I. 4 Units.
The course objective is to advance the students' Hebrew communicative skills by studying the language in its cultural context. The focus will be on speaking, reading, and writing, with an emphasis on the use of the language as reflected in Israeli culture. Prereq: HBRW 102 or consent of department.

HBRW 202. Intermediate Modern Hebrew II. 4 Units.
The course objectives are to enhance and strengthen the students' Hebrew language skills, and to develop the ability to express thoughts, ideas and opinions freely, in both verbal and written forms. Prereq: HBRW 201 or consent of department.

HBRW 301. Advanced Modern Hebrew I. 3 Units.
The course objectives are to enhance the students' language skills and to develop their ability to use an advanced level of Hebrew effectively. Classes will be conducted in Hebrew, and will focus on speaking, reading, and writing with an emphasis on active and creative use of the language. Prereq: HBRW 202 or consent of department.

HBRW 302. Advanced Modern Hebrew II. 3 Units.
The course objectives are to enhance the students' language skills within the domain of Modern Hebrew literature, and to enable them to use their Hebrew skills to perform detailed literary analyses in Hebrew. Classes will be conducted in Hebrew. Prereq: HBRW 301 or consent of department.

HBRW 399. Independent Studies. 1 - 3 Units.
The course is for students with special interests and commitments that are not fully addressed in regular courses, and who wish to work independently. Prereq: HBRW 301 or consent of department.

ITAL Courses

ITAL 101. Elementary Italian I. 4 Units.
Introductory course; stress on mastery of the sound system and basic sentence structure of spoken and written Italian. Independent laboratory practice is a requirement.

ITAL 102. Elementary Italian II. 4 Units.
Continuation of ITAL 101; independent laboratory practice is required in addition to scheduled class meetings. Prereq: ITAL 101.

ITAL 201. Review and Progress in Italian. 4 Units.
Emphasizes language and culture. Review of Italian grammar and usage while studying written forms. Independent laboratory practice is required in addition to scheduled class meetings. Prereq: ITAL 102 or equivalent.

ITAL 202. Read and Discuss Italian Texts. 4 Units.
Focus on increasing proficiency acquired in elementary Italian and on mastering short narratives. Review of Italian grammar and usage through reading, conversation, and media. Independent laboratory practice is required in addition to scheduled class meetings. Prereq: ITAL 201 or equivalent.
ITAL 311. Conversation in Italian. 3 Units.
Focused on oral communication, ITAL 311 is designed to enhance listening/comprehension skills in Italian. Using audio-visual materials, students acquire the skills necessary to understand conversations between native-speakers and to emulate them. The situational and functional approach to the course facilitates progress towards advanced-level fluency in Italian. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ITAL 202 or equivalent.

ITAL 370. Special Topics in Italian Literature. 3 Units.
Special topics in Italian literature, literary criticism, and culture. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ITAL 202 or equivalent.

ITAL 399. Independent Study. 1 - 3 Units.
The course is for students with special interests and commitments that are not fully addressed in regular courses, and who wish to work independently.

JAPN Courses

JAPN 101. Elementary Japanese I. 4 Units.
Introduction to understanding, speaking, reading, and writing Japanese. Students learn to read and write hiragana and katakana syllabaries and 50 kanji characters. Students are expected to achieve control of the sound system and basic structure of the language. Emphasizes aural comprehension and speaking.

JAPN 102. Elementary Japanese II. 4 Units.

JAPN 201. Intermediate Japanese I. 4 Units.
Further study of fundamental structures of Japanese. Students improve aural comprehension, speaking, reading, and writing abilities and learn approximately 100 new characters. Recommended preparation: JAPN 102 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 202. Intermediate Japanese II. 4 Units.
Continuation of JAPN 201. Students learn an additional 100 kanji characters. With the completion of JAPN 201 - 202, students should have control of the fundamentals of modern Japanese and a firm foundation in the writing system. Recommended preparation: JAPN 201 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 225. Japanese Popular Culture. 3 Units.
This course highlights salient aspects of modern Japanese popular culture as expressed in animation, comics and literature. The works examined include films by Hayao Miyazaki, writings by Kenji Miyazawa, Haruki Murakami and Banana Yoshimoto, among others. The course introduces students to essential aspects of modern Japanese popular culture and sensibility. Offered as JAPN 225 and WLIT 225. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 245. Classical Japanese Literature in Translation. 3 Units.
Readings, in English translation, of classical Japanese poetry, essays, narratives, and drama to illustrate essential aspects of Japanese culture and sensibility before the Meiji Restoration (1868). Lectures explore the sociohistorical contexts and the character of major literary genres; discussions focus on interpreting the central images of human value within each period. Japanese sensibilities compared to and contrasted with those of Western and other cultures. Offered as JAPN 245 and WLIT 245. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 255. Modern Japanese Literature in Translation. 3 Units.
Focus on the major genres of modern Japanese literature, including poetry, short story, and novel (shosetsu). No knowledge of Japanese language or history is assumed. Lectures, readings, and discussions are in English. Films and slides complement course readings. Offered as JAPN 255 and WLIT 255. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 301. Advanced Japanese I. 4 Units.
Emphasizes conversational proficiency and reading. Students must use the course material offered by the Online Language Learning Center in addition to class meetings. Recommended preparation: JAPN 202 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 302. Advanced Japanese II. 4 Units.
Continuation of JAPN 301; emphasizes conversational proficiency and reading. Japanese life and culture introduced through supplemental materials and activities. Students must use the course material offered by the Online Language Learning Center in addition to class meetings. Recommended preparation: JAPN 301 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 345. Japanese Women Writers. 3 Units.
Contributions of women writers to the literature of pre-modern and modern Japan; investigations of how their works exemplify and diverge from "mainstream" literary practices. Emphasis on the social and cultural contexts of the texts. Offered as JAPN 345 and WLIT 345. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 350. Contemporary Japanese Texts I. 3 Units.
The primary aim of this course is to develop communication skills in Japanese based on that the students have acquired in JAPN 302 or equivalent. The students will read and discuss various texts such as daily conversations, essays, and news scripts with the assistance of vocabulary and kanji (Chinese character) lists and formal grammar explanations. Attention also will be given to enhancing the students’ writing and aural/oral proficiencies through regularly assigned homework, presentations, tape listening, video viewing, and classroom discussion. Recommended preparation: JAPN 302 or equivalent. Counts for CAS Global & Cultural Diversity Requirement.

JAPN 351. Contemporary Japanese Texts II. 3 Units.
This course is a continuation of JAPN 350 and its primary aim overlaps with that of JAPN 350: to develop more sophisticated communication skills in Japanese. Students will read and discuss various texts such as daily conversations, essays, and news scripts largely with the assistance of vocabulary and kanji (Chinese character) lists. Attention will be given to enhancing the students’ writing and aural/oral proficiencies through regularly assigned homework, presentations, tape listening, video viewing, and classrooms discussion. Counts for CAS Global & Cultural Diversity Requirement. Prereq: JAPN 350 or consent of instructor.

JAPN 355. Modern Japanese Novels and the West. 3 Units.
This course will compare modern Japanese and Western novels, drama, and novels. Comparisons will focus on the themes of family, gender and alienation, which subsume a number of interrelated sub-themes such as marriage, home, human sexuality, amae (dependence), innocence, experience, death, God/gods, and nature (the ecosystem). Offered as JAPN 355 and WLIT 355. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.
LING 302. Second Language Acquisition II: Second Language Acquisition Research and Second Language Teaching. 3 Units.

This course will examine various issues in second language acquisition research that are particularly relevant to foreign language teaching and learning. Topics covered will include: the role of input (listening/reading) vs. output (speaking/writing); implicit vs. explicit learning; negative vs. positive evidence (including the role of error correction); affective factors (motivation, anxiety); individual differences; teachability hypothesis and syllabus construction, program design/evaluation, language testing, among others. The purpose of this course is to survey the principal research in the acquisition of second language that is relevant to second language teaching in a classroom setting, and to obtain the state-of-the-art knowledge of the SLA research literature that is relevant to L2 teaching. The focus is not necessarily on the practical application of the SLA research, although we will not exclude discussion of classroom application. Rather, we critically examine and evaluate SLA research and come up with our own syntheses with respect to various issues. To achieve this goal, we should ask following questions in reading and discussing the relevant literature: 1) What are the main claims that the author(s) make(s)? 2) Are the author’s claims sound? If not why? 3) What further research is needed to answer remaining questions? Students will become familiar with the major research issues through their reading of both primary and secondary sources, as well as through lectures and class discussions. The students are required to complete a term project that addresses the issues treated in the course. Offered as LING 302, LING 402, COGS 314 and COGS 414. Prereq: LING 301 or requisites not met permission.

LING 401. Second Language Acquisition I. 3 Units.

This course is an introduction to the growing field of second language acquisition (SLA). SLA seeks to understand the linguistic, psychological and social processes that underlie the learning and use of second language(s). The goal of research is to identify the principles and processes that govern second language learning and use. SLA is approached from three perspectives in the course: 1) as linguistic knowledge; 2) as a cognitive skill; and 3) as a socially and personality-mediated process. Important factors in second language learning will be identified and discussed. These include: age-related differences, the influence of the first language, the role played by innate (universal) principles, the role of memory processes, attitudes, motivation, personality and cognitive styles, and formal versus naturalistic learning contexts. The objective of this course is to survey the principal research in second language acquisition. Students will become familiar with the major research issues through their reading of both primary and secondary sources, as well as through lectures and class discussions. Offered as COGS 312, COGS 412, LING 301 and LING 401.
LING 402. Second Language Acquisition II: Second Language Acquisition Research and Second Language Teaching. 3 Units.
This course will examine various issues in second language acquisition research that are particularly relevant to foreign language teaching and learning. Topics covered will include: the role of input (listening/reading) vs. output (speaking/writing); implicit vs. explicit learning; negative vs. positive evidence (including the role of error correction); affective factors (motivation, anxiety); individual differences; teachability hypothesis and syllabus construction, program design/evaluation, language testing, among others. The purpose of this course is to survey the principal research in the acquisition of second language that is relevant to second language teaching in a classroom setting, and to obtain the state-of-the-art knowledge of the SLA research literature that is relevant to L2 teaching. The focus is not necessarily on the practical application of the SLA research, although we will not exclude discussion of classroom application. Rather, we critically examine and evaluate SLA research and come up with our own syntheses with respect to various issues. To achieve this goal, we should ask following questions in reading and discussing the relevant literature: 1) What are the main claims that the author(s) make(s)? 2) Are the author's claims sound? If not why? 3) What further research is needed to answer remaining questions? Students will become familiar with the major research issues through their reading of both primary and secondary sources, as well as through lectures and class discussions. The students are required to complete a term project that addresses the issues treated in the course. Offered as LING 302, LING 402, COGS 314 and COGS 414. Prereq: LING 401 or requisites not met permission.

MLIT Course
MLIT 327. Gesture in Cognition and Communication. 3 Units.
Most people never notice that when they are talking, they’re also gesturing. Why do we produce these gestures? What can studying them tell us about the human mind? This course surveys scientific research on gesture, exploring topics such as the role of gesture in communication, cross-cultural differences in gesture, and the relationship between gesture and signed languages. The course will focus on gestures produced with speech, but will cover symbolic and ritualized gesture in the visual arts and in dance. Offered as COGS 327, COGS 427 and MLIT 327. Counts as SAGES Departmental Seminar.

PORT Courses
PORT 101. Elementary Portuguese I. 4 Units.
Introductory course. Students achieve control of the sound system and basic sentence structures of spoken and written Portuguese. Students use materials offered through the Language Center in addition to class meetings.

PORT 102. Elementary Portuguese II. 4 Units.
Continuation of PORT 101, emphasizing conversational skills. Prereq: PORT 101 or equivalent.

PORT 201. Intermediate Portuguese I. 4 Units.
PORT 201 is an intermediate language course. It assumes a fair knowledge of basic grammar that is reviewed and expanded. The course needs the student to show a strong determination to engage in conversation in Portuguese, and to commit to develop better writing in Portuguese. The student learns more about cultural aspects in the Portuguese-speaking world. The course is taught completely in Portuguese. Prereq: PORT 102 or equivalent.

PORT 399. Independent Study. 1 - 3 Units.
This course is for students with special interests and commitments that are not addressed in regular courses and who wish to work independently.

RUSN Courses
RUSN 101. Elementary Russian I. 4 Units.
Introductory course emphasizing conversational skills. Students achieve control of alphabet, sound system, and basic sentence structures in spoken and written Russian. Students must use the course material offered by the Online Language Learning Center in addition to class meetings.

RUSN 102. Elementary Russian II. 4 Units.

RUSN 201. Intermediate Russian. 4 Units.
Furthers students’ ability in four basic language skills: understanding, speaking, reading and writing; expands knowledge of Russian grammar and vocabulary. Recommended preparation: RUSN 102.

RUSN 202. Introduction to Contemporary Civilization. 4 Units.
Continuation of RUSN 201; introduces contemporary Russian culture through readings and discussion. Recommended preparation: RUSN 201.

RUSN 210. Russian for Russian heritage speakers who had no exposure to formal education in Russian. 3 Units.
The course is aimed at “heritage speakers” of Russian who grew up speaking Russian in the family without a full Russian educational and cultural background. The course is designed for students who have speaking and comprehension abilities in Russian but have minimum exposure to writing and reading. Students will learn about Russian grammar (spelling rules, punctuation, word-formation, parts of speech). Readings include the works of Russian classical and contemporary authors. Multimedia materials will enhance cultural awareness.

RUSN 311. Advanced Conversation. 3 Units.
Students work to improve fluency in spoken Russian. Topics of conversation include aspects of contemporary civilization; current vocabulary is stressed. Recommended preparation: RUSN 202.

RUSN 370. Special Topics in Russian. 3 Units.
This course is designed to address the students’ and faculty interests in specific themes or issues not otherwise covered in the curriculum. Approaches and content will vary. This course may have a focus that crosses generic, artistic, historical, disciplinary and geographical boundaries. The honing of the analytical and interpretive skills as well as development of Russian language skills are also integral objectives of the course. The class is conducted in Russian. All written assignments are in Russian. Recommended preparation: Two years of Russian. Counts for CAS Global & Cultural Diversity Requirement.

RUSN 375. Russian Literature in Translation. 3 Units.
Topics vary according to student and faculty interest. May include Russian classical and modern literature, cinema, women writers, individual authors. May count towards Russian minor. No knowledge of Russian required. Offered as RUSN 375 and MLIT 375. Counts for CAS Global & Cultural Diversity Requirement.

RUSN 399. Independent Study. 1 - 3 Units.
SPAN Courses

SPAN 101. Elementary Spanish I. 4 Units.
Introductory course. Students achieve control of the sound system and basic sentence structures of spoken and written Spanish. Students must use the course material offered by the Online Language Learning Center in addition to class meetings.

SPAN 102. Elementary Spanish II. 4 Units.
Continuation of SPAN 101, emphasizing conversational skills. Recommended preparation: SPAN 101.

SPAN 201. Intermediate Spanish I. 4 Units.
Intensive review of grammar and usage through readings, discussions, and other activities. Recommended preparation: SPAN 102 or equivalent.

SPAN 202. Intermediate Spanish II. 4 Units.
Continues grammar review of SPAN 201. Students will study texts and cultural documents which focus on contemporary life in Hispanic countries. Recommended preparation: SPAN 201 or equivalent.

SPAN 303. Latin American History through Art, Literature and Cinema. 3 Units.
This course is designed to provide a basic understanding of Latin America and the Caribbean through art, film and literature. Although it will address pertinent historical aspects related to its social, political, cultural and economic development, the course will focus on relevant contemporary issues affecting and transforming the region, such as the role of women, dictatorships vs. democracy, revolutionary movements, endemic poverty, the Indian communities, the role of art and culture, migration to urban centers, the drug war, the role of the Catholic Church and liberation theology, and the presence and intervention of the United State in the region. The course will be taught in English. Offered as SPAN 303 and SPAN 403. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 305. Spanish for Political Science and International Relations. 3 Units.
Spanish 305 is an upper-level Spanish language course designed to give students interested in political science and international relations specific field-related vocabulary and cultural information not found in basic textbooks. The course is divided into two parts: the first deals with political science; the second with international relations. Readings, discussions, and lectures are conducted in Spanish. Prereq: SPAN 202 or requisites not met permission.

SPAN 306. The Cuban Experience: an immersion in its culture and society. 3 Units.
This is a three week study-abroad intensive course that takes place at Editorial Vigía, in Matanzas, Cuba. The course combines the unique advantages of a total immersion environment in Spanish with a classroom curriculum that includes conversation practice and study of relevant cultural, literary and historical issues. Students complete three hours of classroom instruction and an hour and a half of publishing workshop four days per week. In this workshop, they work in the edition of a bilingual book. In addition, they participate in organized visits to historic sites and museums connected to the culture curriculum. The focus of the culture curriculum is the study of Cuban history and culture through its literature, visual arts, films, and music. After applying and being accepted in the program, students meet for personal advising with the program director and attend four different one hour orientation-information meetings in the spring semester. After successful completion of the study-abroad program, students receive 3 upper-level credits in Spanish. The course is interdisciplinary in approach and provides students with the tools they need to analyze and understand the complexities of modern Cuba. Students will have formal classes taught by their professor and talks and meetings with specialists on Cuban literature, art, architecture, history and other aspects of culture and society. In addition, they will attend lectures, participate in discussions, and take field trips that will expose them to many aspects of Cuban culture, such as art, architecture, music, dance, film, literature, artisan work, folklore, history and urban growth. Offered as SPAN 306, SPAN 406, and ETHS 306. Prereq: SPAN 202.

SPAN 307. Spanish Phonetics and Phonology. 3 Units.
Spanish Phonetics and Phonology is designed to introduce students to the study and practice of the sound system of Spanish. The course will focus on the articulatory descriptions of native pronunciations, the differences between letters and sounds, and the classification of sounds. The course will focus mainly on the sounds of Spanish but will also include the differences with English Language sounds. It will also develop awareness of the different dialectal variations of Spanish across the world. In addition, cultural competency will be achieved through a contextualized approach. The main goal of this course is to improve pronunciation and intonation in Spanish with special emphasis in the production of native-like sounds. Prereq: SPAN 202.

SPAN 309. The Buenos Aires Experience. 3 Units.
Three week study-abroad intensive course that takes place in Buenos Aires, Argentina. The course combines the unique advantages of a total immersion environment in Spanish with a classroom curriculum that includes grammar review, conversation practice, and study of relevant cultural issues. The focus of the culture curriculum is the study of the city of Buenos Aires’ history and culture through its literature, visual arts, films, and music. The cultural component is enhanced by visits to historic and cultural sites and museums. Four different one-hour orientation meetings during Spring semester. Prereq: SPAN 202 or equivalent.

SPAN 310. Advanced Composition and Reading. 3 Units.
Designed to facilitate the transition between lower and upper division courses in Spanish, and focus upon the simultaneous development of the reading and writing skills expected of students in all advanced Spanish courses. Prereq: SPAN 202.

SPAN 311. Advanced Spanish Conversation. 3 Units.
Engages students in conversation so that they develop oral proficiency. Short essays and newspaper articles dealing with everyday activities, socio-cultural roles and experiences, and self-awareness and life goals discussed; some literary materials discussed. Prereq: SPAN 202.
SPAN 312. Business Spanish. 3 Units.
Spanish for business is an upper-level language and culture course which is designed for students at the advance intermediate level. The course stresses the vocabulary and expressions used to describe economic and commercial structure, the language to solve problems and conduct negotiations, and the culture of specific aspects of the Spanish world of the business. Students will continue being exposed to listening, speaking, reading and writing through a variety of activities. Prereq: SPAN 202 or permission.

SPAN 313. Spanish for Health Professionals. 3 Units.
Designed for students who are majoring in, or considering a major in, a health-related field. Focus on the vocabulary and expressions needed for the workplace, task-based practical skills, and grammatical structures. Prereq: SPAN 202 or equivalent.

SPAN 314. Practice of Translation. 3 Units.
Students learn necessary skills and techniques for solving linguistic problems in translation. Texts with a variety of contents, including articles from current press, will be translated from English into Spanish and occasionally from Spanish into English. Prereq: SPAN 202.

SPAN 315. Latin American Cultural Conflicts. 3 Units.
Evolution of Latin American socioeconomic characteristics and artistic production up to the present. Class discussions of diverse literary works, social research essays, and testimonials focus on conflicting elements in class structures, ethnicity, and urban modernization as well as family ethos, religious trends, cultural identity, and educational problems. Offered as SPAN 315 and SPAN 415. Prereq: SPAN 202.

SPAN 317. Contemporary Latin American Culture. 3 Units.
An intensive study of Latin American culture and civilization through the examination of its arts: literature, music, film, painting, photography, popular art. Designed to bring together the various strands of Latin American realities, emphasis is placed on the predominant view among Latin American intellectuals that artists and intellectuals have the power and the obligation to modify society. Prereq: SPAN 202.

SPAN 318. Contemporary Spanish Culture. 3 Units.
Study of several key historical moments and several key aspects in contemporary Spain: Spanish civil war, Franco’s dictatorship, and democratic Spain; rural-urban differences, industrialization and migratory movements; nationalism and terrorism; foreign immigration and tourism, the cultural renaissance and the cultural wars in Madrid and Barcelona. Feature films and literary texts will illustrate the issues under study. Prereq: SPAN 202.

SPAN 320. Introduction to Readings in Hispanic Literature. 3 Units.
Introduction to major literary movements and genres, and the works of outstanding authors of Spanish and Latin American literature through close readings and seminar-based discussions of the texts, as well as to disciplinary modes of inquiry and presentation. Requirements include active participation in seminar discussions, oral presentations, tests, and several written assignments, such as response papers, in-class writing exercises, and an analytic essay in Spanish on a research topic of interest to the discipline. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 202.

SPAN 322. Latin American Short Story. 3 Units.
The history and development of the Latin American short story from the nineteenth century to the present. Intertextuality, rise of the Nuevo Cuento, and major characteristics of the works. Offered as SPAN 322 and SPAN 422. Prereq: SPAN 320.

SPAN 325. Hispanic Intellectuals and Society: A Critical Approach. 3 Units.
This course offers an overview of the most important critical approaches to Spanish American culture and literature, with a socio-historical emphasis. Some of the authors we will discuss are Angel Rama, Jose Antonio Cornejo Polar and Nestor Garcia Canclini. We will analyze how the Latin American intellectuals had thought about specific issues such as identity, race, ideology, colonial and post-colonial relations with the metropolis and the process of formation of the nations in the continent. The class, the discussions, exams, oral presentations and papers will be in Spanish. Some of the readings must be in English, but most of them will be in Spanish. Offered as SPAN 325, SPAN 425, ETHS 325, WLIT 325 and WLIT 425. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 320.

SPAN 326. The Fantastic in Latin American Prose. 3 Units.
Introduction to a distinctive trend in contemporary Latin American literature, the prose portrayal of the " fantastic," a new narrative mode in Latin America. Critical examination of selected texts reveals new concepts of space and time and an increasing complexity of structure and style, one which juxtaposes and analyzes fantasy and reality. Offered as SPAN 326 and SPAN 426. Prereq: SPAN 320.

SPAN 331. Spanish Golden Age Literature. 3 Units.
Through close reading and discussion of representative texts, we will study different examples of Spanish and Latin American writing from the Middle Ages, Renaissance and Baroque periods. We will stress connections between Spain and Latin America, as well as cultural and literary topics of special relevance for contemporary Hispanic cultures. Prereq: SPAN 320.

SPAN 333. Contemporary Caribbean Literature. 3 Units.
In addition to developing a general familiarity with the literature and history of this region, students will acquire an awareness of the interrelation of national identity, memory, and language in the texts produced by contemporary Caribbean authors, and of the cultural hybridity characteristic of this production. The themes treated by these authors include colonialism and postcolonialism, cultural and religious syncretism, and sexual politics. Offered as SPAN 333, SPAN 433, ETHS 333, WLIT 333 and WLIT 433. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 320.

SPAN 334. Mexican Literature. 3 Units.
The course studies, through a series of representative literary works, the most significant literary movements and styles in 20th and 21st Centuries Mexican Literature. Special attention will be paid to the political, aesthetic, and philosophical debates that have shaped the development of Mexican literature from the 1920s to the present, and to the different narrative techniques and ideologies that have characterized different historical periods, literary movements, and individual authors’ styles in contemporary Mexican literature. Offered as SPAN 334 and SPAN 434. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 320.

SPAN 339. Latin American Poetic Revolt. 3 Units.
Introduction to most important poets in contemporary Latin America, a region home to a significant number of eminent poets, including Nobel Laureates from Chile, Gabriela Mistral and Pablo Neruda. The course focuses on detailed textual analysis of pivotal works, combined with historical-literary perspective, so students gain insight into the diverse styles and tendencies that reflect the tumultuous history of poetry's development in a relentless search for a Latin American cultural identity. Offered as SPAN 339, SPAN 439, WLIT 339 and WLIT 439. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 320.
SPAN 340. Contemporary Latin-American Narrative. 3 Units.
Students explore the most significant narrative techniques since 1945 in Latin American fiction: Borges, Cortazar, Garcia Marquez, Vargas Llosa, Isabel Allende. Prereq: SPAN 320.

SPAN 342. Latin American Feminist Voices. 3 Units.
Examination of the awakening of feminine and feminist consciousness in the literary production of Latin American women writers, particularly from the 1920s to the present. Close attention paid to the dominant themes of love and dependency; imagination as evasion; alienation and rebellion; sexuality and power; the search for identity and the self-preservation of subjectivity. Readings include prose, poetry, and dramatic texts of female Latin American writers contributing to the emerging of feminist ideologies and the mapping of feminist identities. Offered as SPAN 342, SPAN 442, ETHS 342, WGST 342, WLIT 342, and WLIT 442. Prereq: SPAN 320.

SPAN 343. The New Drama in Latin American. 3 Units.
Representative works of contemporary Latin American drama. Critical examination of selected dramatic works of twentieth-century Latin America provides students insight into the nature of drama and into the structural and stylistic strategies utilized by Latin American dramatists to create the "new theater," one which is closely related to Latin American political history. Offered as SPAN 343, SPAN 434, ETHS 343, WLIT 343 and WLIT 434. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 320.

SPAN 345. Hispanic Autobiographical Writing. 3 Units.
The course studies issues of self-representation through the reading of autobiographical works from different periods from Latin America, Spain, and the U.S., and of theoretical works that address topics of first-person narratives, autobiography, and sub-alternity. Satisfies Global and Cultural Diversity requirement. Offered as SPAN 345 and SPAN 445. Prereq: SPAN 320.

SPAN 351. Hispanic Turn of the Century Literature. 3 Units.
Cultural and political transitions between 19th and 20th Century, between Spain and Latin America, and between literary models. Study of Spanish and Latin American writers and their literary connections (Generation of 1898, modernistas) in the context of colonial conflicts and economic changes. Offered as SPAN 351 and SPAN 451. Prereq: SPAN 320.

SPAN 353. Transatlantic Vanguard. 3 Units.
Presentation of transatlantic tendencies of the early vanguard movements represented by poets from Spain, Central and South America. Beginning with the advent of Modernism in Latin America and Symbolism in Spain, this course will trace the development of resulting movements in the early twentieth century. Surrealism, Creationism, Futurism, Ultraiism and Dadaism forged a vital link between poets and artists from the Americas and their European counterparts. We will focus on the similarities and differences between these "isms" while drawing conclusions about the uniqueness of vanguard movements on both sides of the Atlantic. Offered as SPAN 353 and SPAN 453. Prereq: SPAN 320.

SPAN 356. Afro-Hispanic Literature. 3 Units.
This course will survey the literary and cultural production of writers and artists of African descent in Latin America and the Caribbean, paying attention to both their creative and theoretical texts. Discussion of questions of race and ethnicity will allow students to explore the ways in which these texts reformulate the idea of national identity and cultural belonging in the context of the nation-state, whose traditional centrality is being weakened through the effects of migration and exile. Readings include works by writers from Cuba, Puerto Rico, Dominican Republic, Costa Rica, Colombia, Panama, Ecuador, and Peru. Offered as SPAN 356, SPAN 456, ETHS 356, WLIT 356 and WLIT 456. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 320.

SPAN 358. Latin American Cinema. 3 Units.
This course is designed to introduce students to the basic tools of film analysis as well as to the major trends and movements in Latin American cinema from the 1960s to the present. Through the analysis of representative films from Latin America, the course will examine the development of a variety of cinematic styles, paying particular attention to the historical contexts in which the films were produced and to the political, cultural, and aesthetic debates that surrounded their production. Offered as SPAN 358, SPAN 458, ETHS 358, WLIT 358 and WLIT 458. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SPAN 320 or equivalent.

SPAN 370. Special Topics in Spanish. 3 Units.
This course is designed to respond to students’ and faculty interest in specific themes or issues not otherwise covered in the curriculum. Approaches, content, and instructor will vary and this course may have a focus that crosses generic, artistic, historical, disciplinary, and geographical boundaries. The honing of analytical and interpretative skills as well as the further development of Spanish language skills also are integral objectives of this course. The class is conducted in Spanish. Prereq: SPAN 320 or equivalent.

SPAN 385. Hispanic Literature in Translation. 3 Units.
Critical analysis and appreciation of representative literary masterpieces from Spain and Latin America, and by Hispanics living in the U.S. Texts cover a variety of genres and a range of literary periods, from works by Cervantes to those of Gabriel Garcia Marquez. The course will examine the relationship between literature and other forms of artistic production, as well as the development of the Hispanic literary text within the context of historical events and cultural production of the period. Counts toward Spanish major only as related course. No knowledge of Spanish required. Offered as ETHS 385, ETHS 485, SPAN 385, SPAN 485, WLIT 385, and WLIT 485.

SPAN 397. Honors Thesis I. 3 Units.
Intensive study of a literary, linguistic, or cultural topic with a faculty member, leading to the writing of a research paper in Spanish. Limited to senior majors. Counts for CAS Global & Cultural Diversity Requirement.
SPAN 398. Honors Thesis II. 3 Units.
Continuation of SPAN 397. Limited to senior majors. Permit required. Prereq: SPAN 397.

SPAN 399. Independent Study. 1 - 3 Units.
The course is for students with special interests and commitments that are not fully addressed in regular courses, and who wish to work independently.

SPAN 400. Foreign Language Teaching Methodology Practicum. 3 Units.
This class is a requirement for first-year MA students. This class will allow the Graduate students in Hispanic Studies to improve their teaching skills. Students will learn the most recent theories and methodologies regarding the teaching of a foreign language and will have practical experience dealing with pedagogical situations in a classroom while teaching a foreign language. Students will work and study under the supervision of their instructor. The course is designed as a practicum and it will work as an independent study while the student attends different language and culture classes to observe them. The combination of study and practice will allow the students to reflect about the teaching techniques they will learn.

SPAN 401. Introduction to Critical Theory. 3 Units.
This course is an introduction to the field of critical theory. It examines many of the major theoretical approaches to the study of literary and cultural texts such as Marxism, Post-structuralism, Feminism, and Post-colonial studies. It provides students with a critical map of some of the most influential theoretical approaches to the study of culture as well as with the necessary analytical tools for the interpretation of texts. The course is a requirement for first-year MA students in Hispanic Studies.

SPAN 403. Latin American History through Art, Literature and Cinema. 3 Units.
This course is designed to provide a basic understanding of Latin America and the Caribbean through art, film and literature. Although it will address pertinent historical aspects related to its social, political, cultural and economic development, the course will focus on relevant contemporary issues affecting and transforming the region, such as the role of women, dictatorships vs. democracy, revolutionary movements, endemic poverty, the Indian communities, the role of art and culture, migration to urban centers, the drug war, the role of the Catholic Church and liberation theology, and the presence and intervention of the United State in the region. The course will be taught in English. Offered as SPAN 303 and SPAN 403. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 406. The Cuban Experience: an immersion in its culture and society. 3 Units.
This is a three week study-abroad intensive course that takes place at Editorial Vigía, in Matanzas, Cuba. The course combines the unique advantages of a total immersion environment in Spanish with a classroom curriculum that includes conversation practice and study of relevant cultural, literary and historical issues. Students complete three hours of classroom instruction and an hour and a half of publishing workshop four days per week. In this workshop, they work in the edition of a bilingual book. In addition, they participate in organized visits to historic sites and museums connected to the culture curriculum. The focus of the culture curriculum is the study of Cuban history and culture through its literature, visual arts, films, and music. After applying and being accepted in the program, students meet for personal advising with the program director and attend four different one hour orientation-information meetings in the spring semester. After successful completion of the study-abroad program, students receive 3 upper-level credits in Spanish. The course is interdisciplinary in approach and provides students with the tools they need to analyze and understand the complexities of modern Cuba. Students will have formal classes taught by their professor and talks and meetings with specialists on Cuban literature, art, architecture, history and other aspects of culture and society. In addition, they will attend lectures, participate in discussions, and take field trips that will expose them to many aspects of Cuban culture, such as art, architecture, music, dance, film, literature, artisan work, folklore, history and urban growth. Offered as SPAN 306, SPAN 406, and ETHS 306. Prereq: SPAN 202.

SPAN 415. Latin American Cultural Conflicts. 3 Units.
Evolution of Latin American socioeconomic characteristics and artistic production up to the present. Class discussions of diverse literary works, social research essays, and testimonials focus on conflicting elements in class structures, ethnicity, and urban modernization as well as family ethos, religious trends, cultural identity, and educational problems. Offered as SPAN 315 and SPAN 415.

SPAN 422. Latin American Short Story. 3 Units.
The history and development of the Latin American short story from the nineteenth century to the present. Intertextuality, rise of the Nuevo Cuento, and major characteristics of the works. Offered as SPAN 322 and SPAN 422.

SPAN 425. Hispanic Intellectuals and Society: A Critical Approach. 3 Units.
This course offers an overview of the most important critical approaches to Spanish American culture and literature, with a socio-historical emphasis. Some of the authors we will discuss are Angel Rama, Jose Antonio Cornejo Polar and Nestor Garcia Canclini. We will analyze how the Latin American intellectuals had thought about specific issues such as identity, race, ideology, colonial and post-colonial relations with the metropolis and the process of formation of the nations in the continent. The class, the discussions, exams, oral presentations and papers will be in Spanish. Some of the readings must be in English, but most of them will be in Spanish. Offered as SPAN 325, SPAN 425, ETHS 325, WLIT 325 and WLIT 425. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 426. The Fantastic in Latin American Prose. 3 Units.
Introduction to a distinctive trend in contemporary Latin American literature, the prose portrayal of the "fantastic," a new narrative mode in Latin America. Critical examination of selected texts reveals new concepts of space and time and an increasing complexity of structure and style, one which juxtaposes and analyzes fantasy and reality. Offered as SPAN 326 and SPAN 426.
SPAN 433. Contemporary Caribbean Literature. 3 Units.
In addition to developing a general familiarity with the literature and history of this region, students will acquire an awareness of the interrelation of national identity, memory, and language in the texts produced by contemporary Caribbean authors, and of the cultural hybridity characteristic of this production. The themes treated by these authors include colonialism and postcolonialism, cultural and religious syncretism, and sexual politics. Offered as SPAN 333, SPAN 433, ETHS 333, WLIT 333 and WLIT 433. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 434. Mexican Literature. 3 Units.
The course studies, through a series of representative literary works, the most significant literary movements and styles in 20th and 21st Centuries Mexican Literature. Special attention will be paid to the political, aesthetic, and philosophical debates that have shaped the development of Mexican literature from the 1920s to the present, and to the different narrative techniques and ideologies that have characterized different historical periods, literary movements, and individual authors' styles in contemporary Mexican literature. Offered as SPAN 334 and SPAN 434. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 439. Latin American Poetic Revolt. 3 Units.
Introduction to most important poets in contemporary Latin America, a region home to a significant number of eminent poets, including Nobel Laureates from Chile, Gabriela Mistral and Pablo Neruda. The course focuses on detailed textual analysis of pivotal works, combined with historical-literary perspective, so students gain insight into the diverse styles and tendencies that reflect the tumultuous history of poetry's development in a relentless search for a Latin American cultural identity. Offered as SPAN 339, SPAN 439, WLIT 339 and WLIT 439. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 442. Latin American Feminist Voices. 3 Units.
Examination of the awakening of feminine and feminist consciousness in the literary production of Latin American women writers, particularly from the 1920s to the present. Close attention paid to the dominant themes of love and dependency, imagination as evasion; alienation and rebellion; sexuality and power; the search for identity and the self-preservation of subjectivity. Readings include prose, poetry, and dramatic texts of female Latin American writers contributing to the emerging of feminist ideologies and the mapping of feminist identities. Offered as SPAN 342, SPAN 442, ETHS 342, WGST 342, WLIT 342, and WLIT 442.

SPAN 443. The New Drama in Latin American. 3 Units.
Representative works of contemporary Latin American drama. Critical examination of selected dramatic works of twentieth-century Latin America provides students insight into the nature of drama and into the structural and stylistic strategies utilized by Latin American dramatists to create the "new theater," one which is closely related to Latin American political history. Offered as SPAN 343, SPAN 434, ETHS 343, WLIT 343 and WLIT 434. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 445. Hispanic Autobiographical Writing. 3 Units.
The course studies issues of self-representation through the reading of autobiographical works from different periods from Latin America, Spain, and the U.S., and of theoretical works that address topics of first-person narratives, autobiography, and sub-alternity. Satisfies Global and Cultural Diversity requirement. Offered as SPAN 345 and SPAN 445. Prereq: SPAN 320.

SPAN 451. Hispanic Turn of the Century Literature. 3 Units.
Cultural and political transitions between 19th and 20th Century, between Spain and Latin America, and between literary models. Study of Spanish and Latin American writers and their literary connections (Generation of 1898, modernistas) in the context of colonial conflicts and economic changes. Offered as SPAN 351 and SPAN 451.

SPAN 453. Transatlantic Vanguard. 3 Units.
Presentation of transatlantic tendencies of the early vanguard movements represented by poets from Spain, Central and South America. Beginning with the advent of Modernism in Latin America and Symbolism in Spain, this course will trace the development of resulting movements in the early twentieth century. Surrealism, Creationism, Futurism, Ultranism and Dadaism forged a vital link between poets and artists from the Americas and their European counterparts. We will focus on the similarities and differences between these "isms" while drawing conclusions about the uniqueness of vanguard movements on both sides of the Atlantic. Offered as SPAN 353 and SPAN 453.

SPAN 456. Afro-Hispanic Literature. 3 Units.
This course will survey the literary and cultural production of writers and artists of African descent in Latin America and the Caribbean, paying attention to both their creative and theoretical texts. Discussion of questions of race and ethnicity will allow students to explore the ways in which these texts reformulate the idea of national identity and cultural belonging in the context of the nation-state, whose traditional centrality is being weakened through the effects of migration and exile. Readings include works by writers from Cuba, Puerto Rico, Dominican Republic, Costa Rica, Colombia, Panama, Ecuador, and Peru. Offered as SPAN 356, SPAN 456, ETHS 356, WLIT 356 and WLIT 456. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 458. Latin American Cinema. 3 Units.
This course is designed to introduce students to the basic tools of film analysis as well as to the major trends and movements in Latin American cinema from the 1960s to the present. Through the analysis of representative films from Latin America, the course will examine the development of a variety of cinematic styles, paying particular attention to the historical contexts in which the films were produced and to the political, cultural, and aesthetic debates that surrounded their production. Offered as SPAN 358, SPAN 458, ETHS 358, WLIT 358 and WLIT 458. Counts for CAS Global & Cultural Diversity Requirement.

SPAN 485. Hispanic Literature in Translation. 3 Units.
Critical analysis and appreciation of representative literary masterpieces from Spain and Latin America, and by Hispanics living in the U.S. Texts cover a variety of genres and a range of literary periods, from works by Cervantes to those of Gabriel Garcia Marquez. The course will examine the relationship between literature and other forms of artistic production, as well as the development of the Hispanic literary text within the context of historical events and cultural production of the period. Counts toward Spanish major only as related course. No knowledge of Spanish required. Offered as ETHS 385, ETHS 485, SPAN 385, SPAN 485, WLIT 385, and WLIT 485. Prereq: Graduate standing.

Department of Music

Haydn Hall, 201
http://music.case.edu/
Phone: 216.368.2400; Fax: 216.368.6557
David J. Rothenberg, Department Chair
david.rothenberg@case.edu
The Department of Music offers a range of degree programs and ensemble experiences for undergraduate and graduate students. The degree programs are as follows:

- Music: Bachelor of Arts (BA) with a major in music, Bachelor of Science (BS) in a unit other than the College of Arts and Sciences with a secondary major in music
- Music Education: Bachelor of Science (BS), Master of Arts (MA), Master of Arts for Teacher Licensure (MAL), Doctor of Philosophy (PhD)
- Historical Performance Practice: Master of Arts (MA), Doctor of Philosophy (PhD), Doctor of Musical Arts (DMA)
- Musicology: Doctor of Philosophy (PhD)

Since 1968, the department has participated in a Joint Music Program (JMP) with the Cleveland Institute of Music (http://www.cim.edu) (CIM). Through the JMP, students enjoy the advantages of a top research university while receiving conservatory-level training in theory and performance. They also benefit from our active collaborations with the Cleveland Orchestra, the Rock and Roll Hall of Fame and Museum, the Cleveland Museum of Art, the Music Settlement, and other local cultural and educational institutions.

The Department of Music offers private instruction through the JMP. Music majors should consult with their program advisor before registering for lessons. Non-major students interested in private instruction should visit the department office (Haydn 201) to begin the lesson registration process and learn further details (there are additional fees for non-music majors).

A number of music ensembles (http://music.case.edu/ensembles) are open to all students. Entrance into the primary ensembles may be subject to a gateway audition; others require an audition for part assignment. Students may elect to earn up to one credit unit per semester for participation. Auditions for ensembles are held during the first week of classes each semester. Further information is available on the department website (http://music.case.edu).

Facilities

Haydn Hall (https://goo.gl/ghQde8)
Haydn Hall houses the Department of Music faculty and staff offices, classrooms, the Kulas Music Library, the Music Education Resource Center, and The Core (see below). It is located in the heart of the Mather Quad. Originally a combination of a dormitory and classrooms, this building served as the only student center on campus. It was given to the college by Flora Stone Mather and named in honor of Hiram Collins Haydn, fifth president of Western Reserve University, pastor of the Old Stone Church, and the individual most active in convincing Western Reserve College to move to Cleveland. Charles F. Schweinfurth, the premier residential architect of Euclid Avenue ("Millionaires' Row") mansions, who also rebuilt the interior of the Old Stone Church in 1883 and designated Trinity Cathedral, designed Haydn Hall.

Florence Harkness Memorial Chapel (https://goo.gl/bKg9gA)
Harkness Chapel (http://music.case.edu/facilities/florence-harkness-memorial-chapel), built in 1902, features neo-Gothic architecture, antique oak and Georgia pine woodwork, and Tiffany windows. It is a warm, intimate, and acoustically resonant space for the performance of vocal and instrumental chamber music. The building provides space for concerts, music classes, and department recitals. Harkness Chapel was built to honor Florence Harkness Severance, the only daughter of Stephen Harkness and his second wife, Anna M. Richardson Harkness.

Maltz Performing Arts Center (https://case.edu/maltzcenter)
The Milton and Tamar Maltz Performing Arts Center at The Temple–Tifereth Israel opened in 2015 after extensive restoration and renovation of the structure, which first opened as a synagogue in 1924. Today, the center is an active venue for performances and events, including lectures and music concerts. Located at 1855 Ansel Road at East 105th Street, it includes Silver Hall, a 1,000-seat concert hall for large ensemble performances, and Koch Hall, a 90-seat recital hall for smaller performances.

Denison Hall (https://goo.gl/uauDeZ)
Denison Hall, located near Wade Commons (the main hub for the North Residential Village), is used primarily for ensemble rehearsals. This facility houses several Wenger practice modules, one of which is a "virtual reality" acoustic room; a percussion studio; and a music library. Classrooms include the Wade Rehearsal Hall, Denison Rehearsal Hall, and Denison Chamber Room. The facility also has storage rooms for marching band uniforms/equipment and instrument storage lockers (available to music majors and students enrolled in ensembles). In general, the classrooms in Denison Hall are to be utilized by students who are music majors or are enrolled in music ensembles (MUEN) or applied music lessons (MUAP).

Kulas Music Library (https://goo.gl/YkTB5n)
Kulas Music Library is a satellite library of Kelvin Smith Library, the university's main library. It contains more than 45,000 items, including music scores, books on music, sound recordings, video recordings, microforms, and music periodicals. The library contains a listening room for use of the sound recording and video collections. Music majors at the university also have access to the Robinson Music Library of the Cleveland Institute of Music. The Case Western Reserve University Kulas Music Library and the CIM Robinson Music Library coordinate acquisitions and services, and their collections reflect institutional strengths while also supporting the CWRU/CIM Joint Music Program.

The Core (http://music.case.edu/facilities/the-core)
The Core is a Macintosh computer classroom and lab dedicated to mind, sound, and vision. The Core is a collaborative space for all CWRU students, faculty, and staff, as well as the University Circle community, to gather, collaborate, and design in visual and aural mediums. It not only offers computers and software, but also video and digital cameras and microphones for checkout, one-on-one tutorial time, classes, and a meeting space. The Core also donates computers to local students and classrooms in need.

Kulas Collection of Early Instruments (http://music.case.edu/centers-and-areas-of-study/historical-performance-practice)
The department maintains an impressive collection of modern reproductions of early instruments. The instruments are used by the Collegium Musicum, the CWRU/CIM Baroque Orchestra, and the department's program in historical performance practice. The collection includes medieval, Renaissance, and baroque strings, as well as brass, woodwinds, and keyboards.

Music Education Resource Center
The department provides a resource center for music education students to prepare educational materials and research projects. The center is located in Haydn Hall, Room 12, and contains a variety of audiovisual media, including a library of education-oriented music software. Students may borrow items from a large collection of music textbooks, educational...
requirements, testing materials, vocal and instrumental books, curriculum guides, and classroom instruments. Use of this center is encouraged, and sometimes required, for many of the projects and assignments in courses throughout the music education curriculum.

Details about Department of Music practice rooms, operating hours, general usage guidelines, and building access, etc., are available online within the Music Facilities Summary Guide & Procedures (http://music.case.edu/facilities/room-reservation-information).

Undergraduate Programs

Majors

The Department of Music offers majors in music (a BA degree in the College of Arts and Sciences or a BS degree in a unit other than the college with music as a secondary major) and music education (BS degree). Students who wish to major in music or music education must pass a performance audition on an acceptable primary instrument or in voice and take a music theory placement test. Arrangements for all auditions and for the theory placement test must be made by following the procedures listed on the department website (http://music.case.edu). All performance and course requirements are detailed in the Undergraduate Music Handbook (http://music.case.edu/undergraduate-handbooks).

Double Major, Dual-Degree, and Secondary Major Opportunities. The department encourages qualified students to consider a double major in music and another subject. More than one half of music majors at Case Western Reserve pursue a double major. Typical combinations include the BA in music with theater, English, classics, psychology, sociology, or the natural sciences. Once the SAGES and General Education Requirements have been met, a BA student can add another major by meeting the course and hour requirements found in this bulletin under the appropriate department. In most cases, it is possible to finish a double major with music in four years.

It is also possible to receive two degrees, although this may take more than four years. Typical combinations of dual degrees include the BA in music with the BS in engineering, or the BS in music education with the BM degree from the Cleveland Institute of Music. All admissions requirements must be met for each school, and course and hour requirements for each degree must be fulfilled. Students interested in dual degrees should declare their intent as early as possible and receive advice from faculty about both degrees.

Finally, students completing a BS in a unit other than the College of Arts and Sciences (for example, a BS in engineering) can choose music as a secondary major within that BS degree. Students pursuing music as a secondary major only need to meet the SAGES and General Education Requirements of the school in which they are earning their degree.

Music Major - BA degree (or a BS degree with a secondary major in music)

This major requires that 43–51 of the credit hours necessary for the degree be devoted to music study.

Requirements for the major in music are as follows:

Applied instruction on primary instrument:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MUAP 121</td>
<td>Principal Performance Area I</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 122</td>
<td>Principal Performance Area II</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 10</td>
<td>Progress Jury Examination</td>
<td>0</td>
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Ensemble participation:

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MUAP 221</td>
<td>Principal Performance Area III</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 222</td>
<td>Principal Performance Area IV</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 20</td>
<td>Level 300 Applied Music Entrance</td>
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<tr>
<td></td>
<td>Jury Exam</td>
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<tr>
<td>MUAP 321</td>
<td>Principal Level Performance Area V</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 322</td>
<td>Principal Level Performance Area VI</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 30</td>
<td>BA Performance Exit Jury Examination</td>
<td>0</td>
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</tbody>
</table>

Eight semesters of ensemble participation for 0–1 credits each, of which six semesters must be in a Primary Ensemble designated for the student’s primary instrument. Primary ensembles for each instrument are listed in the Undergraduate Music Handbook.

Music theory and eurhythmics:

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MUTH 107</td>
<td>Theory for Music Majors I (CIM class)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>or MUTH 101 Harmony-Keyboard I</td>
<td></td>
</tr>
<tr>
<td>MUTH 105</td>
<td>Sightsinging-Eartraining</td>
<td></td>
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<tr>
<td>MUTH 108</td>
<td>Theory for Music Majors II (CIM class)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>or MUTH 102 Harmony-Keyboard II</td>
<td></td>
</tr>
<tr>
<td>MUTH 106</td>
<td>Sightsinging-Eartraining II</td>
<td></td>
</tr>
<tr>
<td>MUTH 207</td>
<td>Theory for Music Majors III (CIM class)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>or MUTH 201 Harmony-Keyboard III</td>
<td></td>
</tr>
<tr>
<td>MUTH 205</td>
<td>Sightsinging-Eartraining III</td>
<td></td>
</tr>
<tr>
<td>MUTH 208</td>
<td>Theory for Music Majors IV (CIM class)</td>
<td>4</td>
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<tr>
<td></td>
<td>or MUTH 202 Harmony-Keyboard IV</td>
<td></td>
</tr>
<tr>
<td>MUDE 101</td>
<td>Eurhythmics I</td>
<td>0</td>
</tr>
<tr>
<td>MUDE 102</td>
<td>Eurhythmics II</td>
<td>0</td>
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Music history:

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<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MUHI 201</td>
<td>History of Western Music I</td>
<td>3</td>
</tr>
<tr>
<td>MUHI 202</td>
<td>History of Western Music II</td>
<td>3</td>
</tr>
</tbody>
</table>

Electives in music history/analysis/education/audio recording:

Students must take 9 credit hours of elective courses drawn from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MUHI at 300 level or higher</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>MUTH at 300 level</td>
<td></td>
<td></td>
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<tr>
<td>MUED 240 (Foundations of Music Education, 3 credits)</td>
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<tr>
<td>MUED 310 (Instrumental and Choral Arranging, 3 credits)</td>
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<tr>
<td>MUED 391 (Music in early Childhood, 3 credits)</td>
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<tr>
<td>MUED 275 (Elements of Conducting, 2 credits – instructor permission required)</td>
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<tr>
<td>MUED 276 (Advanced Conducting, 2 credits – instructor permission required)</td>
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<tr>
<td>MUED 200A–P (Skills and Pedagogy, 1 credit each – instructor permission required)</td>
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BS in Music Education

The mission of the Music Education Program is to prepare proactive scholar-practitioners who can incorporate productive attitudes (positivity,
passion, and resilience) with professional skills (critical thinking, creative
inquiry, and reflection) to demonstrate outcomes of a lifelong learner/educator (effective teaching to empower students). Proactive individuals
will look for opportunities to lead and distinguish themselves in a positive
manner, using scholarship (academic skills and resources) to effectively
practice their craft (teach).

The nationally recognized program faculty are active in their respective
professional organizations and as clinicians, conductors, lecturers, and
researchers.

The BS degree in music education requires a total of 122 credits and is
designed to educate professional teachers of music education for public
and private schools. The program meets the requirements of the Ohio
Department of Education to prepare students to take state-mandated
teacher exams (Ohio Assessments for Educators) and apply for teacher
licensure. Most states recognize the Ohio teaching license through
reciprocity.

Music education students benefit from a wide range of instrumental,
vocal, and general classroom methods courses. As an additional part
of the program, students benefit from plentiful hands-on experiences by
teaching sample lessons and conducting rehearsals in actual teaching
situations.

Requirements for the BS in music education are as follows:

A. Core courses:

**A. Core Courses**

Music theory/Musicianship; eurythmics:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUTH 107</td>
<td>Theory for Music Majors I (CIM class)</td>
<td>4</td>
</tr>
<tr>
<td>or MUTH 101</td>
<td>Harmony-Keyboard I</td>
<td></td>
</tr>
<tr>
<td>MUTH 105</td>
<td>Sightsinging-Eartraining I</td>
<td></td>
</tr>
<tr>
<td>MUTH 108</td>
<td>Theory for Music Majors II (CIM class)</td>
<td>4</td>
</tr>
<tr>
<td>or MUTH 102</td>
<td>Harmony-Keyboard II</td>
<td></td>
</tr>
<tr>
<td>MUTH 106</td>
<td>Sightsinging-Eartraining II</td>
<td></td>
</tr>
<tr>
<td>MUTH 207</td>
<td>Theory for Music Majors III (CIM class)</td>
<td>4</td>
</tr>
<tr>
<td>or MUTH 201</td>
<td>Harmony-Keyboard III</td>
<td></td>
</tr>
<tr>
<td>MUTH 205</td>
<td>Sightsinging-Eartraining III</td>
<td></td>
</tr>
<tr>
<td>MUTH 208</td>
<td>Theory for Music Majors IV (CIM class)</td>
<td>4</td>
</tr>
<tr>
<td>or MUTH 202</td>
<td>Harmony-Keyboard IV</td>
<td></td>
</tr>
<tr>
<td>MUTH 320</td>
<td>Form and Analysis (CIM class)</td>
<td>3</td>
</tr>
<tr>
<td>MUDE 101</td>
<td>Eurhythmics I (Fulfills SAGES Phys Ed requirement; CIM class)</td>
<td>0</td>
</tr>
<tr>
<td>MUDE 102</td>
<td>Eurhythmics II (Fulfills SAGES Phys Ed requirement; CIM class)</td>
<td>0</td>
</tr>
</tbody>
</table>

Music history/literature:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUED 305</td>
<td>World Music in Education (Fulfills SAGES Global and Cultural Diversity requirement)</td>
<td>3</td>
</tr>
<tr>
<td>MUHI 201</td>
<td>History of Western Music I</td>
<td>3</td>
</tr>
<tr>
<td>MUHI 202</td>
<td>History of Western Music II</td>
<td>3</td>
</tr>
</tbody>
</table>

Applied music lessons (every semester except student teaching):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUAP 121</td>
<td>Principal Performance Area I</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 122</td>
<td>Principal Performance Area II</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 10</td>
<td>Progress Jury Examination</td>
<td>0</td>
</tr>
<tr>
<td>MUAP 221</td>
<td>Principal Performance Area III</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 222</td>
<td>Principal Performance Area IV</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 20</td>
<td>Level 300 Applied Music Entrance Jury Exam</td>
<td>0</td>
</tr>
<tr>
<td>MUAP 321</td>
<td>Principal Level Performance Area V</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 322</td>
<td>Principal Level Performance Area VI</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 323</td>
<td>Principal Performance Area VII</td>
<td>2</td>
</tr>
<tr>
<td>MUAP 35</td>
<td>BS Music Education Jury Examination</td>
<td>0</td>
</tr>
</tbody>
</table>

Ensembles:

- Required Primary Ensemble (every semester except student teaching) ¹

- Added ensemble (one full year, keyboard students may sign up for MUEN 386 as their added ensemble)

B. Music Education Sequence

Methods: ²

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUED 240</td>
<td>Foundations of Music Education</td>
<td>3</td>
</tr>
<tr>
<td>MUED 300</td>
<td>Intensive Field Experience</td>
<td>0</td>
</tr>
<tr>
<td>MUED 320</td>
<td>Technology Assisted Music Teaching and Learning</td>
<td>3</td>
</tr>
<tr>
<td>MUED 350</td>
<td>General Music Methods</td>
<td>3</td>
</tr>
<tr>
<td>MUED 352</td>
<td>Instrumental Methods and Materials</td>
<td>3</td>
</tr>
<tr>
<td>or MUED 353</td>
<td>Choral Methods and Materials</td>
<td></td>
</tr>
</tbody>
</table>
| MUED 355    | Vernacular Music in Education
(Fulfills SAGES Departmental Seminar requirement) | 3 |

Conducting and arranging:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUED 275</td>
<td>Elements of Conducting</td>
<td>3</td>
</tr>
<tr>
<td>MUED 276</td>
<td>Advanced Conducting, Score Analysis and Rehearsal Techniques</td>
<td>3</td>
</tr>
<tr>
<td>MUED 310</td>
<td>Instrumental and Choral Arranging</td>
<td>3</td>
</tr>
</tbody>
</table>

Secondary instrument classes: ²

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUED 200A</td>
<td>Basic Skills and Pedagogy: Voice</td>
<td>1</td>
</tr>
<tr>
<td>MUED 200B</td>
<td>Basic Skills and Pedagogy: Guitar</td>
<td>1</td>
</tr>
<tr>
<td>MUED 200C</td>
<td>Basic Skills and Pedagogy: Brass</td>
<td>1</td>
</tr>
<tr>
<td>MUED 200E</td>
<td>Basic Skills and Pedagogy: Clarinet and Saxophone</td>
<td>1</td>
</tr>
<tr>
<td>MUED 200F</td>
<td>Basic Skills and Pedagogy: Double Reeds and Flute</td>
<td>1</td>
</tr>
<tr>
<td>MUED 200H</td>
<td>Basic Skills and Pedagogy: Strings</td>
<td>1</td>
</tr>
<tr>
<td>MUED 200P</td>
<td>Basic Skills and Pedagogy: Percussion</td>
<td>1</td>
</tr>
</tbody>
</table>

Student teaching:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUED 396A</td>
<td>Student Teaching in Music Education</td>
<td>9</td>
</tr>
<tr>
<td>MUED 396B</td>
<td>Student Teaching Seminar in Music Education</td>
<td>3</td>
</tr>
</tbody>
</table>

C. Professional Education Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 301</td>
<td>Introduction to Education</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 304</td>
<td>Educational Psychology</td>
<td>3</td>
</tr>
</tbody>
</table>
SAGES Requirements

22 hours in addition to those major courses that fulfill SAGES requirements

1. Strings: MUEN 385 Case/University Circle Orchestra
   Winds/Percussion: MUEN 383 Symphonic Winds
   Piano: MUEN 389 Keyboard Ensemble
   Voice: MUEN 382 Case Concert Choir
   Guitar: MUEN 355 Miscellaneous Ensembles

2. See: Required Methods and Secondary Instrument Courses by Music Education Focus Area, below

3. PSCL 101 General Psychology I is a prerequisite

Required Methods and Secondary Instrument Courses by Music Education Focus Area

Choral/General Focus

Required Methods Specialization Class:

MUED 353 Choral Methods and Materials

Secondary Instruments:

MUED 200A Basic Skills and Pedagogy: Voice
MUED 200B Basic Skills and Pedagogy: Guitar
MUED 200C Basic Skills and Pedagogy: Brass
MUED 200H Basic Skills and Pedagogy: Strings
MUED 200P Basic Skills and Pedagogy: Percussion

One of the following:

MUED 200E Basic Skills and Pedagogy: Clarinet and Saxophone
MUED 200F Basic Skills and Pedagogy: Double Reeds and Flute

Instrumental Focus - Winds/Percussion

Required Methods Specialization Class:

MUED 352 Instrumental Methods and Materials

Secondary Instruments:

MUED 200A Basic Skills and Pedagogy: Voice
MUED 200C Basic Skills and Pedagogy: Brass
MUED 200E Basic Skills and Pedagogy: Clarinet and Saxophone
MUED 200F Basic Skills and Pedagogy: Double Reeds and Flute
MUED 200H Basic Skills and Pedagogy: Strings
MUED 200P Basic Skills and Pedagogy: Percussion

Instrumental Focus - Strings

Required Methods Specialization Class:

MUED 352 Instrumental Methods and Materials

Secondary Instruments:

MUED 200A Basic Skills and Pedagogy: Voice
MUED 200C Basic Skills and Pedagogy: Brass
MUED 200E Basic Skills and Pedagogy: Clarinet and Saxophone
MUED 200F Basic Skills and Pedagogy: Double Reeds and Flute
MUED 200H Basic Skills and Pedagogy: Strings

Admission and Retention in Music Education

There are five decision points in the Music Education Program. For each of the decision points, there are three possible outcomes:

1. unconditional admission to the next level; conditional admission with a prescribed action plan which when successfully completed will result in unconditional admission; or denial of admission. Denial of admission at any decision point means the student is no longer able to pursue a music education degree at Case Western Reserve.

Decision Point 1: Application for Admission to the Program

Official admission to the Music Education Program generally occurs at the end of the third semester of study. Admission to the program requires:

1. admission to Case Western Reserve University
2. acceptance as a music major through an audition process before matriculation
3. successful completion of MUED 240 Foundations of Music Education, including evaluation of an initial Teaching ePortfolio
4. a cumulative Case Western Reserve University GPA of 2.7 or better
5. submission of a signed Statement of Assurance of Good Moral Character, and
6. a satisfactory interview with music education faculty, documented on the Teacher Licensure Admission Assessment Form

Decision Point 2: Application for Advanced Standing

Application for Advanced Standing should be submitted by the end of the second semester after Decision Point 1 (usually during the fifth semester of study). Application for Advanced Standing requires:

1. a successful review of the updated Teaching ePortfolio
2. submission of a current Academic Requirements Report documenting the following: a cumulative GPA of 2.7 or better, a music GPA of 2.7 or better, and an education GPA of 3.0 or better
3. a passing score on the Candidate Disposition Assessment Inventory completed by the student and the music education faculty

Decision Point 3: Application for Student Teaching

Application for Student Teaching should be completed by the end of the semester prior to student teaching (seventh semester of study). The application requires:

1. a successful review of the updated Teaching ePortfolio
2. submission of a current Academic Requirements Report documenting the following: a cumulative GPA of 2.7 or better, a music GPA of 2.7 or better, and an education GPA of 3.0 or better
3. a passing score on the Candidate Disposition Assessment Inventory completed by the student and the music education faculty
4. passing a TB test
5. presenting documentation of Hepatitis B vaccination
6. passing an official criminal background check
7. a satisfactory interview with music education faculty

Decision Point 4: Retention during Student Teaching

Retention during Student Teaching should be completed by midterms of the student teaching semester. The assessment requires:

1. a passing score on the Candidate Disposition Assessment Inventory completed by the student and the music education faculty
2. passing scores on the Case Student Teaching Mid-Semester Assessment by the cooperating teacher(s) and university supervisor
3. completion of a self-reflective essay

**Decision Point 5: Application for Initial Licensure**
Application for Initial Licensure occurs after successful completion of all degree requirements. This application requires:

1. a successful review of the updated Teaching ePortfolio
2. submission of a current Academic Requirements report documenting the following: a cumulative GPA of 2.7 or better, a music GPA of 2.7 or better, and an education GPA of 3.0 or better
3. a passing score on the Candidate Disposition Assessment
4. passing scores on Ohio licensure exams
5. completion of the Case Teacher Licensure Exit Interview and Survey
6. passing scores on the Case Student Teaching Final Assessment by the cooperating teacher(s) and university supervisor
7. successful completion of Student Teaching course work with a grade of B or better

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUGE 201</td>
<td>Introduction to Music: Listening Experience I</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 212</td>
<td>History of Rock and Roll</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 215</td>
<td>History and Styles of Jazz</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 220</td>
<td>Composers of the Musical on Stage and Screen</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 271</td>
<td>Composers of the Musical on Stage and Screen</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 302</td>
<td>Musical Experience in Music</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 308</td>
<td>Digital Music: Composition and Production</td>
<td>3</td>
</tr>
</tbody>
</table>

After successfully completing all requirements at the five decision points, the student is recommended by the university's director of teacher education for the Ohio Provisional Music (Pre-K-12) License to teach music in public schools in Ohio and more than 40 reciprocating states.

Completion of the BS degree does not ensure that the State of Ohio music teacher license will be awarded. Additional information is available from the Teacher Licensure (p. 522)section in this bulletin.

**Departmental Honors**
Students of exceptional merit majoring in music or music education may earn their degree “with departmental honors,” a distinction that appears on the transcript, is announced at Commencement, and is printed in the Commencement program. Students in the music major who maintain a GPA of 3.75 in the major and complete an ambitious and outstanding Music Capstone project (MUHI 395A-B) can earn departmental honors by faculty nomination and vote of the Department of Music faculty. For BS students in music education, admission to honors status requires advanced standing in music education. Music education majors who maintain a GPA of 3.75 in the major and receive a high score on their Teacher Work Sample Project from the Music Education faculty can earn departmental honors by vote of the Department of Music faculty.

**Minor**
The music minor requires 15 units: 6 in music theory (MUTH), 6 in music history or appreciation (MUHI or MUGN), and 3 others, which may include MUAP or MUEN. For questions regarding eligible course substitutions, please contact the Department of Music Minor Advisor.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUTH 103</td>
<td>Theory I</td>
<td>3</td>
</tr>
<tr>
<td>MUTH 104</td>
<td>Theory II</td>
<td>3</td>
</tr>
</tbody>
</table>

Music History: Any two MUHI or MUGN courses 6
At least 3 additional credit units in MUGN, MUHI, MUAP, or MUEN 3
Total Units 15

A minor in music education may be devised in consultation with a music education advisor. CIM students may pursue a minor in music history by taking 15 hours of MUHI courses. The department welcomes students’ initiative in the development of minor programs suited to their needs. Courses can be substituted with the approval of the music minor program advisor.

**Electives for Non-Music Majors**
Electives designed for students not majoring in music are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUGE 201</td>
<td>Introduction to Music: Listening Experience I</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 212</td>
<td>History of Rock and Roll</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 215</td>
<td>History and Styles of Jazz</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 220</td>
<td>Composers of the Musical on Stage and Screen</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 271</td>
<td>Composers of the Musical on Stage and Screen</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 302</td>
<td>Musical Experience in Music</td>
<td>3</td>
</tr>
<tr>
<td>MUGE 308</td>
<td>Digital Music: Composition and Production</td>
<td>3</td>
</tr>
</tbody>
</table>

Ensembles (http://music.case.edu/ensembles) (MUEN) are open to all students. Placement auditions are required. For more information about the department's ensemble offerings, please contact the individual ensemble director.

Music lessons for students not majoring in music (http://music.case.edu/music-lessons-for-students-not-majoring-in-music) are available with consent of the department (there are additional fees for non-music majors). For more information about the department's applied music (MUAP) offerings, please visit the Current Student/General (http://music.case.edu/general) section of the Department of Music website.

**Graduate Programs**
General descriptions are given here; complete information on all degrees is available from the Department of Music Graduate Student Handbook (http://music.case.edu/graduate-handbooks). Admission to each degree follows established guidelines of the School of Graduate Studies (https://case.edu/gradstudies). The Graduate Students: Apply to the University (http://music.case.edu/prospective-graduate-students/apply-to-the-university) section of the music webpage outlines in detail the procedures and timeline for submitting an application.

**MA Degree**
The MA degree is offered in the fields of:

1. music history and literature (with possible concentration in historical performance practice)
2. music education
MA in Music History and Literature

This degree emphasizes research, history, literature, and the theory of music. The following are minimum requirements:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bibliography and Research</td>
<td>3</td>
</tr>
<tr>
<td>Music History</td>
<td>9</td>
</tr>
<tr>
<td>Theory-Analysis</td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td>6-12</td>
</tr>
<tr>
<td>Thesis</td>
<td>6</td>
</tr>
<tr>
<td>Total Units</td>
<td>30-36</td>
</tr>
</tbody>
</table>

The concentration in historical performance practice presupposes the same strong liberal arts training as the music history and literature concentration, plus a strong performance interest and background. Research and its application to music performance are emphasized. The following are minimum requirements:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bibliography and Research</td>
<td>3</td>
</tr>
<tr>
<td>Historical Performance Practice</td>
<td>12</td>
</tr>
<tr>
<td>Lessons and Ensembles</td>
<td>12</td>
</tr>
<tr>
<td>Lecture-Recital and Document</td>
<td>3</td>
</tr>
<tr>
<td>Music History</td>
<td>6</td>
</tr>
<tr>
<td>Total Units</td>
<td>36</td>
</tr>
</tbody>
</table>

Examinations include initial placement tests in history and theory, and a reading test in a foreign language pertinent to the student's field. In addition, performance practice students must audition as part of the admissions process and play one jury. At least 18 credit hours must be at the 400 level or higher.

MA in Music Education

This degree is built on a set of foundation courses in philosophy, curriculum, psychology, research, evaluation, and musicianship. Additional courses and independent studies enable students to tailor programs to their interests and needs.

Three degree options are available. Students who choose Plan A (thesis option) write a thesis based on original research and defend the thesis in an oral examination. Students who choose Plan B (comprehensive exam option) complete a comprehensive examination in music education. Applicants for Plans A or B should have a bachelor's degree in music education, an undergraduate GPA of 3.0 or better, and at least one year of successful music teaching experience, usually in the public schools.

Students seeking teacher licensure credentials pursue Plan C (MA for Licensure, or MAL). The program includes a core of graduate music education courses, graduate music courses, undergraduate music education methods courses, and one semester of student teaching. Applicants for the MAL should have a bachelor's degree in music (BA or BM), an undergraduate GPA of 3.0 or better, and some prior experience in working with children. The regulations for students in the BS program regarding advanced standing, grade point averages, and the Ohio Assessments for Educators exam apply to graduate students in Plan C as well. Completion of the Plan C degree does not ensure that the State of Ohio music teacher license will be awarded.

Foundation courses for Plan A and Plan B include the following ranges:

<table>
<thead>
<tr>
<th>Area</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music education core of philosophy, curriculum, and research</td>
<td>12-15</td>
</tr>
<tr>
<td>Music core of history, theory, and applied music</td>
<td>9-12</td>
</tr>
</tbody>
</table>

Electives 3-9

Total Units 24-36

Students in Plan A receive 6 credit hours for thesis research. Students in Plan B complete a comprehensive written examination at the conclusion of course work, whereas students in Plan C complete a comprehensive oral examination.

A minimum of 30 credit hours is required for Plans A and B. Plan C requires a minimum of 65 hours, including:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music education licensure core</td>
<td>35</td>
</tr>
<tr>
<td>Teacher licensure professional education core</td>
<td>9</td>
</tr>
<tr>
<td>Graduate music education core</td>
<td>12</td>
</tr>
<tr>
<td>Graduate music core</td>
<td>9</td>
</tr>
<tr>
<td>Total Units</td>
<td>65</td>
</tr>
</tbody>
</table>

To remain in Plan C's MAL program, students must meet GPA and professional standards each year. For more information, contact the area head of music education.

PhD Degree

The PhD degree is offered in two fields: (1) musicology (with concentrations in historical musicology and historical performance practice), and (2) music education.

PhD in Musicology

The PhD in historical musicology is granted in recognition of superior scholarly ability and attainment. Award of the degree is based not only on computation of time or enumeration of courses, but also upon distinguished work. Highly qualified applicants may enter this program directly upon completion of a bachelor's degree. All programs of study are formulated to suit the individual needs of the student and require the consent of the advisor.

Historical Musicology Concentration

The PhD requires 36 credit hours of course work and an additional 18 credit hours of dissertation research. Required course work includes MUHI 610 Bibliography and Research Methods in Music and MUHI 612 Analysis for Music Historians as well as three doctoral seminars. In the first two years, students will be expected to take three courses (or 9 credits) per semester, for a total of 36 hours.

Students admitted to the program will take diagnostic examinations prior to the start of classes in their first year. Based on these examinations, students may be required to enroll in specific courses to address deficiencies; these course credits may be applied toward the degree requirements. In December of each year, students will submit an Academic Progress Report (APR).

Written evaluations included as part of this report, along with course grades and materials, will constitute the beginnings of the portfolio maintained by the coordinator of graduate studies that will be the basis for considering each student's advancement into the PhD program.

At the beginning of the fall in the third year of study, students will take comprehensive examinations, which will also function as qualifying exams for advancement to the PhD program. These examinations will consist of written and oral sections, and will be conducted and evaluated by the musicology faculty. Following the examinations, the faculty will review each student's portfolio and, based on work contained therein, make a decision regarding advancement to candidacy in the PhD...
program. Students who do not advance but who have done satisfactory work will be eligible to receive the MA in music history at this juncture.

Students who advance to candidacy for the PhD will register for dissertation research credits and begin research for the dissertation. Working with a faculty advisor, each student will develop a proposal for the dissertation, which will be presented in writing to the faculty no later than March 15 at the end of the third year of study. This document should be submitted at least two weeks prior to a prospectus defense, scheduled no later than April 1. It is expected that the fourth and fifth year of study will be devoted to work on the dissertation; during this time, students will enroll in MUHI 710: Dissertation Seminar. Upon completion of the thesis, each student will present a formal defense to the musicology faculty. The Graduate Student Handbook (http://music.case.edu/graduate-handbooks) outlines in detail the procedures and timeline for dissertation completion and graduation.

Under the rules of the School of Graduate Studies, a student must complete the thesis no later than five years after registering for the first dissertation research (701) credits.

Historical Performance Practice Concentration

The PhD in historical musicology with a concentration in historical performance practice requires a minimum of 36 hours of course work, seminars, and tutorials, and an additional 18 credit hours of dissertation research. Course distribution is as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bibliography and research</td>
<td>3</td>
</tr>
<tr>
<td>Performance practices</td>
<td>9</td>
</tr>
<tr>
<td>Notation-theory</td>
<td>9</td>
</tr>
<tr>
<td>Doctoral Seminars</td>
<td>6</td>
</tr>
<tr>
<td>MUHI 751</td>
<td>1-3</td>
</tr>
<tr>
<td>Total Units</td>
<td>28-30</td>
</tr>
</tbody>
</table>

Remaining hours are freely elected in music history and research with the advisor’s approval. At least three semesters of applied music (0 credits) are required. Ensemble participation is also required for performance practice students but does not earn credit hours toward the degree.

For other musicology students, private lessons at the 500 level, although not required, may be counted up to a maximum of six credits, at the discretion of the advisor.

Examinations include initial placement tests in history and theory; reading tests in two foreign languages pertinent to the student’s field; and comprehensive examinations in history and theory, including written and oral sections, prior to admission to candidacy. Upon completion of the dissertation, an oral defense is held. In addition, performance practice students must audition as part of the admissions process. The candidate must teach a college-level course in music history and literature (or historical performance practice) under the supervision of a faculty member, or have had the equivalent experience before the dissertation is completed.

PhD in Music Education

The doctorate in music education is offered to persons who have shown a strong and continuing dedication to music teaching and scholarship. Applicants must have completed at least three years of full-time music teaching, usually in the public schools. The degree is designed to prepare professionals to assume positions of leadership in elementary, secondary, and collegiate instruction. Prior to graduation, doctoral students demonstrate competency in teaching, research, and musicianship. Every effort will be made to plan a program based on individual student needs and interests while maintaining standards of musical and scholarly excellence. Electives, therefore, will be chosen in consultation with a faculty advisor in order to ensure a balance between individual interests and traditional graduate expectations. To remain in the program, students must meet GPA and professional standards each year. For more information, contact the area head of music education.

A total of 60 credit hours is required for the doctoral degree beyond the master’s level. Courses include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music education: research, philosophy, cognition/psychology, curriculum, and assessment</td>
<td>15</td>
</tr>
<tr>
<td>Music: theory, history, applied music</td>
<td>9-12</td>
</tr>
<tr>
<td>Outside cognate</td>
<td>6</td>
</tr>
<tr>
<td>Music education electives</td>
<td>9-12</td>
</tr>
<tr>
<td>Dissertation</td>
<td>18</td>
</tr>
<tr>
<td>Total Units</td>
<td>57-63</td>
</tr>
</tbody>
</table>

A qualifying examination follows the completion of course work, prior to beginning research for the dissertation. Upon completion of the dissertation, an oral defense is held. The dissertation topic is chosen by the student in consultation with the faculty.

DMA in Historical Performance Practice

This doctorate is granted in recognition of outstanding performing ability in early music combined with superior scholarly ability in the field of historical performance practice. All programs are formulated to suit the needs of the individual student and require the consent of a faculty advisor.

A minimum of 36 hours of coursework, seminars, and tutorials is required. Distribution is as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Total Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUHI 751</td>
<td>1-3</td>
</tr>
<tr>
<td>MUAP 700</td>
<td>1-3</td>
</tr>
<tr>
<td>Total Units</td>
<td>26-39</td>
</tr>
</tbody>
</table>

Lessons and Ensembles must be taken every semester the student is on campus (18-24 credit units).

Examinations include a performance audition; initial placement tests in history and theory; reading tests in two foreign languages pertinent to the student’s field; and a comprehensive examination with history, theory, performance practice, and oral sections. Exceptional students may be admitted to a combined MA/DMA degree program in early music.

Applied Music

All MA and PhD degree students in the department must satisfy the applied music requirements specified in their degree programs. Graduate students who anticipate private lesson instruction in their programs should consult an advisor before registration. Students register for individual applied music instruction in courses titled Principal Performance Area and Secondary Performance Area.
Department Faculty

David J. Rothenberg, PhD
(Yale University)
Associate Professor and Chair
Medieval and Renaissance music

Julie Andrijeski, DMA
(Case Western Reserve University)
Senior Instructor; Director of CWRI/CIM Baroque Orchestra
Historical performance; dance

L. Peter Bennett, D Phil
(Oxford University)
Associate Professor
17th-century French music; historical performance

Francesca Brittan, PhD
(Cornell University)
Associate Professor
19th-century France; Romantic aesthetics; popular music

Eric Charnofsky, MM
(The Juilliard School)
Instructor; Coordinator of Undergraduate Enrollment
20th-century music; piano accompanying; keyboard repertoire

Georgia J. Cowart, PhD
(Rutgers University)
Professor; Coordinator of Graduate Studies in Musicology
17th and 18th centuries; music, the arts, and politics

Ross W. Duffin, DMA
(Stanford University)
Fynette H. Kulas Professor of Music; Head of Historical Performance Practice
Historical Performance Practice; Shakespeare

Paul S. Ferguson, MM
(Eastman School of Music)
Senior Instructor
Jazz studies and arranging

Matthew L. Garrett, PhD
(Florida State University)
Associate Professor; Coordinator of Undergraduate Studies in Music (BA) and Music Education (BS); Director of Choirs
Music teacher education; choral music education; conducting

Daniel Goldmark, PhD
(University of California, Los Angeles)
Professor; Head of Popular Music Studies; Director of the Center for Popular Music Studies
American popular music; film music; history of the music industry

Kathleen A. Horvath, PhD
(The Ohio State University)
Associate Professor; Director of Orchestras
Music teacher education; string education and pedagogy

Lisa L. Koops, PhD
(Michigan State University)
Associate Professor; Head of Music Education
Music teacher education; general music

Nathan B. Kruse, PhD
(Michigan State University)
Associate Professor; Coordinator of Graduate Studies in Music Education
Music teacher education; research methods

Susan McClary, PhD
(Harvard University)
Professor; Head of Musicology
16th and 17th-century music; cultural criticism; music theory and analysis; 21st-century opera

Robert Walser, PhD
(University of Minnesota)
Professor
American music; jazz history; popular music studies; contemporary music production technology

MUAP Courses

MUAP 10. Progress Jury Examination. 0 Unit.
Progress Jury Examination (All BA and BS Music Majors)

MUAP 20. Level 300 Applied Music Entrance Jury Exam. 0 Unit.
Level Jury Examination

MUAP 25. BA Exit Jury Examination. 0 Unit.
BA Exit Jury Examination (Audio and General Music Concentrations)

MUAP 26. BA Exit Jury Examination. 0 Unit.
BA Exit Jury Examination (Music History, Music Theory, and Early Music Performance Practice)

MUAP 30. BA Performance Exit Jury Examination. 0 Unit.
BA Performance Exit Jury Examination

MUAP 35. BS Music Education Jury Examination. 0 Unit.
BS Music Education Jury Examination

MUAP 121. Principal Performance Area I. 2 Units.
Limited to music and music education majors. Recommended preparation: Entrance Jury/Audition

MUAP 122. Principal Performance Area II. 2 Units.
Limited to music and music education majors. Prereq: MUTH 3 and MUAP 121. Coreq: MUTH 3.

MUAP 131. Secondary Performance. 1 - 2 Units.
Secondary instrumental or vocal instruction (undergraduate level). Each student has the option of taking one-hour weekly lessons (2 credit units) or half-hour weekly lessons (1 credit unit). The applied lesson fee is waived for all music majors. Contact the Department of Music directly for registration consent.

MUAP 221. Principal Performance Area III. 2 Units.
Limited to music and music education majors. Prereq: MUTH 107 or MUTH 101/105, MUAP 122, Passed Progress Jury. Coreq: MUTH 107 or MUTH 101/105.

MUAP 222. Principal Performance Area IV. 2 Units.

MUAP 223. Principal Performance Area V. 2 Units.
Limited to music and music education majors. Prereq: MUTH 207 or MUTH 201/205, MUAP 222. Coreq: MUTH 207 or MUTH 201/205.

MUAP 224. Principal Performance Area VI. 2 Units.
Limited to music and music education majors. Prereq: (MUTH 208 or MUTH 202) and MUAP 223. Coreq: MUTH 208 or MUTH 202.
MUAP 225. Principal Performance Area VII. 2 Units.
Limited to music and music education majors. Prereq: MUAP 224.

MUAP 226. Principal Performance Area VIII. 2 Units.
Limited to music and music education majors. Prereq: MUAP 225.

MUAP 321. Principal Level Performance Area V. 2 Units.

MUAP 322. Principal Level Performance Area VI. 2 Units.
Limited to music and music education majors. Prereq: (MUTH 208 or MUTH 202) and MUAP 321. Coreq: MUTH 208 or MUTH 202.

MUAP 323. Principal Performance Area VII. 2 Units.
Limited to music performance and music education majors.

MUAP 324. Principal Performance Area VIII. 2 Units.
Limited to music performance and music education majors.

MUAP 421. Principal Level Performance Area VII. 2 Units.
Limited to music and music education majors. Prereq: MUAP 322.

MUAP 422. Principal Level Performance Area VII. 2 Units.
Limited to music and music education majors. Prereq: MUAP 421.

MUAP 500. Applied Music/Ensembles. 1 - 3 Units.
Registration to reflect combined participation in a number of Historical Performance Ensembles, each of which is taken for 0 credit hours.

MUAP 521. Principal Performance Area IX. 0 - 3 Units.
Limited to music and music education majors.

MUAP 522. Principal Performance Area IX. 0 - 3 Units.
Limited to music and music education majors.

MUAP 523. Principal Performance Area IX. 0 - 3 Units.
Limited to music and music education majors.

MUAP 524. Principal Performance Area IX. 0 - 3 Units.
Limited to music and music education majors.

MUAP 525. Principal Performance Area IX. 0 - 3 Units.
Limited to music and music education majors.

MUAP 526. Principal Performance Area IX. 0 - 3 Units.
Limited to music and music education majors.

MUAP 531. Secondary Performance. 0 - 3 Units.
Secondary instrumental or vocal instruction (graduate level). Each student not majoring in music has the option of taking one-hour weekly lessons (2 credit units) or half-hour weekly lessons (1 credit unit). Graduate students in music may be advised by their program advisor to take this course for variable credit (0-3 units). The applied lesson fee is waived for all music majors. Contact the Department of Music directly for registration consent.

MUAP 600. Historical Performance Progress Jury. 0 Unit.
Historical Performance Progress Jury, generally taken at the end of the second semester.

MUAP 601. Principal Performance Lessons. 3 Units.

MUAP 602. Principal Performance Lessons. 3 Units.

MUAP 651. M.A. Lecture - Recital and Document. 3 - 6 Units.
M.A. Lecture - Recital for students in Historical Performance Practice.

MUAP 700. Historical Performance Recital. 0 Unit.
Historical Performance Recital. Intended to demonstrate mastery of historically-informed performance in a number of different national styles.

MUAP 751. Doctoral Lecture-Recital and Document I. 0 - 3 Units.

MUAP 752. Doctoral Lecture-Recital and Document II. 3 Units.

MUAP 753. Doctoral Lecture-Recital and Document III. 1 - 6 Units.

MUAR Courses

MUAR 151B. Case Audio Internship I. 1 Unit.
Development of recording engineering skills through professional level work in the Harkness audio service. Recommended preparation: Open only to audio recording majors.

MUAR 152B. Case Audio Internship II. 1 Unit.
Recommended preparation: MUAR 151B.

MUAR 153B. Case Audio Internship III. 1 Unit.
Recommended preparation: MUAR 152B.

MUAR 154B. Case Audio Internship IV. 1 Unit.
Recommended preparation: MUAR 153B.

MUAR 200. Audio Recording I. 2 Units.
A study of basic recording principles and systems and techniques of recording and editing. Recommended preparation: Audio recording majors only.

MUAR 201. Audio Recording II. 2 Units.
Further study of basic recording principles and systems with an introduction to digital recording. Recommended preparation: MUAR 200.

MUAR 202. Pro Tools Production I. 2 Units.
Pro Tools is the Industry standard for digital Audio Production. This course follows the avid curriculum for Pro Tools user certification. Requires a personal laptop computer (Mac preferred) with Pro Tools 10 and the complete production toolkit software. Prereq: Audio Recording majors only.

MUAR 203. Pro Tools Production II. 2 Units.
Pro Tools is the Industry standard for digital Audio Production. This course follows the avid curriculum for Pro Tools user certification. Requires a personal laptop computer (Mac preferred) with Pro Tools 10 and the complete production toolkit software. Prereq: MUAR 203 and Audio Major.

MUAR 250. Audio Recording for Non-Majors. 2 Units.
This is a hands-on course for musicians who wish to understand the processes for recording music and speech that will be beneficial to their musical careers. Topics include microphone techniques, signal processing, delivering audio masters, computer workstations, audio software and the business of music.

MUAR 251B. Case Audio Recording Internship I. 0 Unit.
Professional level work in the Case Western Reserve University Harkness audio service.

MUAR 252B. Case Audio Recording Internship II. 0 Unit.

MUAR 253B. Case Audio Recording Internship III. 0 Unit.

MUAR 254B. Case Audio Recording Internship IV. 0 Unit.

MUAR 300. Advanced Recording Techniques I. 2 Units.
A study of advanced microphone, recording, and monitoring systems and techniques with an emphasis on two track digital recordings of classical music and critical listening. Recommended preparation: MUAR 201.

MUAR 301. Advanced Recording Techniques II. 2 Units.
Further study of advanced microphone, recording, and monitoring systems and techniques, with an emphasis on two track digital recordings of large ensemble classical music. Recommended preparation: MUAR 300.
MUAR 302. Multitrack Recording Techniques I. 2 Units.
A study of multitrack recording and mixdown techniques. Recommended preparation: MUAR 301. Audio recording majors only.

MUAR 303. Multitrack Recording Techniques II. 2 Units.
Further study of multitrack recording and mixdown techniques, with an emphasis on synchronization to video. Recommended preparation: MUAR 302.

MUAR 310. Recording Studio Maintenance I. 1 Unit.
Study of techniques for optimizing professional recording equipment performance. Recommended preparation: MUAR 201. Audio recording majors only.

MUAR 311. Recording Studio Maintenance II. 1 Unit.

MUAR 320. Acoustics of Music I. 1 Unit.
A seminar in the basic concepts of musical acoustics and research in this area. The students actively participate in experiments exploring various topics in musical acoustics.

MUAR 321. Acoustics of Music II. 1 Unit.
A seminar in the basic concepts of musical acoustics and research in this area. The students actively participate in experiments exploring various topics in musical acoustics.

MUAR 322. Recording Workshop I. 1 Unit.
Recording Workshop provides an increased level of hands-on intensive study of microphone placement. Each week a different instrument or group of instruments will be available for experimentation. Each class represents a recording session centered on a specific instrument, resulting in a comprehensive set of test recordings at the end of each semester. These will provide the basis of reference for future recording decisions. Recommended preparation: MUAR 200.

MUAR 323. Recording Workshop II. 1 Unit.
Recording Workshop provides an increased level of hands-on intensive study of microphone placement. Each week a different instrument or group of instruments will be available for experimentation. Each class represents a recording session centered on a specific instrument, resulting in a comprehensive set of test recordings at the end of each semester. These will provide the basis of reference for future recording decisions. Recommended preparation: MUAR 200.

MUAR 380. Junior Recording Techniques Thesis. 3 Units.

MUAR 385. Recording Studio Internship. 4 Units.

MUAR 390. Senior Recording Tech Thesis/Senior Capstone. 6 Units.
Students will originate, design, organize, and complete a project that will demonstrate and document proficiency with his/her accumulated audio recording technology skills. This project must include evidence of critical thinking, clear planning, and establishment of reasonable goals with an appropriate plan of action. There is a significant written component that requires regular submission of drafts, progress reports, evidence of project advancement, and a final written document. There must also be a public presentation of the project in a venue approved by the department. Counts as SAGES Senior Capstone.

MUCP Courses

MUCP 399. Undergraduate Independent Studies. 1 - 3 Units.
Each student develops a topic of interest to be explored with a faculty member.

MUCP 400. Composition Seminar. 0 Unit.

MUCP 501. Composition Independent Study. 1 Unit.

MUAR Courses

MUAR 302. Multitrack Recording Techniques I. 2 Units.
A study of multitrack recording and mixdown techniques. Recommended preparation: MUAR 301. Audio recording majors only.

MUAR 303. Multitrack Recording Techniques II. 2 Units.
Further study of multitrack recording and mixdown techniques, with an emphasis on synchronization to video. Recommended preparation: MUAR 302.

MUAR 310. Recording Studio Maintenance I. 1 Unit.
Study of techniques for optimizing professional recording equipment performance. Recommended preparation: MUAR 201. Audio recording majors only.

MUAR 311. Recording Studio Maintenance II. 1 Unit.

MUAR 320. Acoustics of Music I. 1 Unit.
A seminar in the basic concepts of musical acoustics and research in this area. The students actively participate in experiments exploring various topics in musical acoustics.

MUAR 321. Acoustics of Music II. 1 Unit.
A seminar in the basic concepts of musical acoustics and research in this area. The students actively participate in experiments exploring various topics in musical acoustics.

MUAR 322. Recording Workshop I. 1 Unit.
Recording Workshop provides an increased level of hands-on intensive study of microphone placement. Each week a different instrument or group of instruments will be available for experimentation. Each class represents a recording session centered on a specific instrument, resulting in a comprehensive set of test recordings at the end of each semester. These will provide the basis of reference for future recording decisions. Recommended preparation: MUAR 200.

MUAR 323. Recording Workshop II. 1 Unit.
Recording Workshop provides an increased level of hands-on intensive study of microphone placement. Each week a different instrument or group of instruments will be available for experimentation. Each class represents a recording session centered on a specific instrument, resulting in a comprehensive set of test recordings at the end of each semester. These will provide the basis of reference for future recording decisions. Recommended preparation: MUAR 200.

MUAR 380. Junior Recording Techniques Thesis. 3 Units.

MUAR 385. Recording Studio Internship. 4 Units.

MUAR 390. Senior Recording Tech Thesis/Senior Capstone. 6 Units.
Students will originate, design, organize, and complete a project that will demonstrate and document proficiency with his/her accumulated audio recording technology skills. This project must include evidence of critical thinking, clear planning, and establishment of reasonable goals with an appropriate plan of action. There is a significant written component that requires regular submission of drafts, progress reports, evidence of project advancement, and a final written document. There must also be a public presentation of the project in a venue approved by the department. Counts as SAGES Senior Capstone.

MUED Courses

MUED 200A. Basic Skills and Pedagogy: Voice. 1 Unit.
Designed for music education majors to provide the fundamentals of teaching methods for various instruments. Recommended preparation: Music education majors. Non-music majors accepted with consent of department.

MUED 200B. Basic Skills and Pedagogy: Guitar. 1 Unit.
Designed for music education majors to provide the fundamentals of teaching methods for various instruments. Recommended preparation: Music education majors. Non-music majors accepted with consent of department.

MUED 200C. Basic Skills and Pedagogy: Brass. 1 Unit.
This course is designed to provide music education majors with basic skills and pedagogy in the areas of group and individual brass instruction techniques. The course will consist of two components: applied study on each brass instrument; and study/discussion of current pedagogical practices. Students need not have completed any prior music education courses prior to enrolling.

MUED 200D. Basic Skills and Pedagogy: Clarinet and Saxophone. 1 Unit.
Designed for music education majors to provide the fundamentals of teaching methods for various instruments. Recommended preparation: Music education majors. Non-music majors accepted with consent of department.

MUED 200F. Basic Skills and Pedagogy: Double Reeds and Flute. 1 Unit.
Designed for music education majors to provide the fundamentals of teaching methods for various instruments. Recommended preparation: Music education majors. Non-music majors accepted with consent of department.

MUED 200H. Basic Skills and Pedagogy: Strings. 1 Unit.
Designed for music education majors to provide the fundamentals of teaching methods for various instruments. Recommended preparation: Music education majors. Non-music majors accepted with consent of department.

MUED 220. Marching Band Techniques. 1 Unit.
This course is designed to provide music education majors with the training and techniques to effectively direct a marching band. Topics will include rehearsal methodology, drill design, and arranging. The course will meet synchronously with the CWRU Marching Spartans as the lab portion of the class and at a time TBD once per week to cover the content areas. Coreq: MUEN 384.

MUED 240. Foundations of Music Education. 3 Units.
An introduction to and overview of the music education profession. Philosophical, historical and psychological perspectives on music education in schools, including contemporary topics and trends. Introduction of Ohio academic content standards and curriculum model for music, along with K-12 National Music Standards. Observation of area music teachers and peer-teaching experience. Recommended preparation: Music education major or permission.
MUED 275. Elements of Conducting. 3 Units.
This course is designed to develop the cognitive, affective and psychomotor skills necessary for students to communicate effectively with performing ensembles. Students will learn to listen, think, and communicate verbally and nonverbally through systematic exercises, in order to prepare for ensemble rehearsal and performance experiences.

MUED 276. Advanced Conducting, Score Analysis and Rehearsal Techniques. 3 Units.
This course is designed to continue development of the cognitive, affective and psychomotor skills necessary for students to communicate effectively with performing ensembles. Students will learn to listen, think, and communicate nonverbally through systematic exercises, in order to prepare for ensemble rehearsal and performance experiences. In addition, students will apply foundational study of musical forms to score analysis and score preparation. Students will also develop a working vocabulary of rehearsal techniques for use with instrumental and vocal ensembles.

Prereq: MUED 275.

MUED 300. Intensive Field Experience. 0 Unit.
This course is intended for BS and MA-Licensure music education majors, and acquaints students with various teaching settings in P-12 schools in the greater Cleveland area; allows students to observe and teach with practicing music teachers; and fosters critical thinking skills related to effective teaching, lesson planning, and other elements of teaching.
Offered as MUED 300 and MUED 400. Prereq: MUED 240, MUED 305, and MUED 350. Coreq: MUED 355 and (MUED 352 or MUED 353).

MUED 305. World Music in Education. 3 Units.
This course acquaints students with the use of world music, or multicultural music, in the music education classroom. Students are given an overview of the history of world music within American music education, discuss topics related to world music in education, research diverse world music practices, and lead lessons based on this research. Topics and content include: definitions of world/multicultural music; philosophical basis for world music in education; diversity in our Cleveland community; authenticity; ethnomusicology; informal/formal music learning; international perspectives; pedagogical approaches; addressing the State and National Standards through world music in education; and the development of culturally informed music pedagogy based on the study of diverse music. Throughout the course students will become acquainted with the music of diverse cultures and people groups; these will be chosen in part based on student’s own research interests. In addition to the musical cultures chosen by students for study and presentation, the music of The Gambia, West Africa; the Caribbean; and India will be highlighted during in-class activities and lessons.

MUED 310. Instrumental and Choral Arranging. 3 Units.
Techniques of writing and arranging for instruments of the band and orchestra and voice. Study of scoring problems for school instrumental and vocal groups of all ages and abilities.

MUED 320. Technology Assisted Music Teaching and Learning. 3 Units.
Fundamental concepts and skills for using technology in music teaching and learning. This project-oriented class will develop knowledge and competencies related to electronic musical instruments, MIDI sequencing, music notation software, computer-assisted instruction, digital media, the Internet, information processing, computer systems, and lab management as they relate to music education in K-12 schools.
Recommended preparation: MUED 240. Offered as MUED 320 and MUED 420.

MUED 350. General Music Methods. 3 Units.
General Music Methods introduces student to methods and materials for planning and implementing general music experiences for all ages, with concentration on Pre-K through sixth grade children. Topics of the course include: multiple meanings of music for children; characteristics/needs of young children and creating a supportive learning environment; theories of music learning and teaching; learning styles and collaborative learning; assorted teaching methods, rhythm, pitch, listening, movement, performing, composing; curriculum design; technology for music instruction; multicultural music; music for exceptional children; integrating music with the arts and other curricula; motivation and classroom management; lesson planning and record keeping; developing a personal philosophy of music education; national, state, and professional standards; and assessment. Clinical/Field experiences (Clinical-all ages; Field-focus on Pre-K through elementary) required.

MUED 352. Instrumental Methods and Materials. 3 Units.
This course acquaints students with effective ways to develop, organize and maintain a successful instrumental program for any age group, based on a comprehensive instrumental music education model. Students are given a "womb to tomb" view of the instrumentalists' development, including physiological development and age appropriate instrumental exceptions. Topics and content include: philosophical basis for music education, considerations for selecting repertoire including multicultural music; rehearsal techniques; assessment and record keeping; planning for the rehearsal; recruitment, auditioning, and placement; motivation and classroom management; team teaching and collaborative learning; managing an instrumental program; participation in professional activities; effective use of technology in the instrumental program; philosophy; and national, state, and professional standards. Clinical/Field experiences (all ages) required.

MUED 353. Choral Methods and Materials. 3 Units.
This course acquaints students with effective ways to develop, organize and maintain a successful choral program for any age group, based on a comprehensive choral music education model. Students review fundamental vocal pedagogy of the singing voice, including physiological development, age appropriate vocal expectations, and establishing and maintaining vocal health. Topics include: philosophical basis for vocal music education; the child voice, the adolescent voice, and the adult voice; vocal tone; considerations for selecting repertoire including ensemble assessment, music evaluation, and multicultural music; rehearsal techniques, collaborative learning, and motivation; planning for the rehearsal; developing conducting technique; recruitment, auditioning, placement, score analysis and preparation; classroom management; managing a choral program; participation in professional activities; effective use of technology in a choral program; and national state, and professional standards. Clinical/Field experiences (all ages) required. Recommended preparation: MUED 276.
MUED 355. Vernacular Music in Education. 3 Units.
This Music Education Department Seminar brings together all strands of the Music Education program by focusing on curriculum as the organizational element of instruction. Topics and content include: understanding the issues presented by special learners; techniques for integrating special learners into the music teaching environment; developing learning outcomes; designing instruction; planning classroom experiences; defining assessment and measurement; assessment techniques and instruments for the music classroom; and exploring elements of school music program organization and administration. Professional writing and clinical and field experiences will be a large part of the activities in this course. This course is presented in a seminar format that provides for discussions of classroom topics and commentary on field experiences. Counts as SAGES Departmental Seminar.

MUED 391. Music in Early Childhood. 3 Units.
The goal of the course is to provide students with an understanding of the role of music in early childhood and approaches to music education with young children. Students will experience an overview of selected theories of musical development of young children, discuss the importance of music to various areas of child development, explore cultural perspectives and influences on musical development, evaluate curricular materials and methods used in early childhood music education, observe children's music making in early childhood classrooms, and develop teaching skills for early childhood music settings. Topics and content of this course include: music's role in early childhood development; music aptitude and its measurement; theories of early childhood music learning; early childhood making; evaluating curricular materials for early childhood music; the importance of play in early childhood musical development; incorporating State and National Music Education Standards; designing instruction for early childhood music settings; assessment in early childhood music; cultural perspectives on music in early childhood; cultural influences on musical development; music therapy with young children; benefits of family interaction in music; the role of listening in early childhood musical development; and formal music instruction with young children. The class will participate in a weekly service learning project providing music instruction for young children and parents or caregivers from an underserved population. Offered as MUED 391 and MUED 491.

MUED 396A. Student Teaching in Music Education. 9 Units.
Teaching music in both elementary and secondary schools, full-time five days a week for 15 weeks. Closely supervised field experiences of all types with a wide variety of students. Emphasis on planning lessons and organizing materials, teaching methodologies, motivation, and student assessment. Topics addressed include communications and the arts, technology in learning, interdisciplinary learning, collaborative learning and teaching, creating a supportive environment, and professional development. Development of skills needed for self-assessment as well as student assessment. Clinical/Field experiences (all ages) required. Recommended preparation: Concurrent enrollment in MUED 396B. Offered as MUED 396A and MUED 496A. Counts as SAGES Senior Capstone. Prereq: EDUC 255 and MUAP 323 and MUAP 35.

MUED 396B. Student Teaching Seminar in Music Education. 3 Units.
This is the SAGES Senior Capstone requirement for students majoring in Music Education. Taken at the same time as the student teaching experience (MUED 396A/496A), this seminar will guide students through preparation for entering the professional world of music education, and mentor them in their preparation of their Senior Capstone Project and Presentation. Recommended preparation: Concurrent enrollment in MUED 496A. Offered as MUED 396B and MUED 496B. Counts as SAGES Senior Capstone.

MUED 399. Undergraduate Independent Studies. 1 - 3 Units.
Each student develops a topic of interest to be explored with a faculty member.

MUED 400. Intensive Field Experience. 0 Unit.
This course is intended for BS and MA-Licensure music education majors, and acquaints students with various teaching settings in P-12 schools in the greater Cleveland area; allows students to observe and teach with practicing music teachers; and fosters critical thinking skills related to effective teaching, lesson planning, and other elements of teaching. Offered as MUED 300 and MUED 400. Prereq: MUED 305, MUED 350, and MUED 410. Coreq: MUED 355 and (MUED 352 or MUED 353).

The role of a Music Educator is complex and involves the practical application of music content in various Pre K-12 teaching environments. This course is designed for entering Master of Arts with Teaching License majors who have a performance-based undergraduate education to give a comprehensive overview of the profession and facilitate the journey and transition from music student to professional music educator. Prereq: Admission into the Master of Arts with Teacher License Music Education Program.

MUED 420. Technology Assisted Music Teaching and Learning. 3 Units.
Fundamental concepts and skills for using technology in music teaching and learning. This project-oriented class will develop knowledge and competencies related to electronic musical instruments, MIDI sequencing, music notation software, computer-assisted instruction, digital media, the Internet, information processing, computer systems, and lab management as they relate to music education in K-12 schools. Recommended preparation: MUED 240. Offered as MUED 320 and MUED 420.

MUED 440. Scholarship in Music Education. 3 Units.
In MUED 440 we will be examining critically the research of others. We will explore the various paradigms and methods in music education research and will learn to become educated consumers of published research. In addition, we will be learning the beginnings of how to conduct our own research. Specific topics of this course include utilizing music education research tools, resources, and materials; identifying and generating research problems; reviewing related literature; designing research procedures; conducting quantitative and qualitative research studies; and writing empirical research reports and proposals. Writing skills are an important part of this course, for unless one can convey the findings of his or her research to other people with clarity, that research will be of limited value. Prereq: Graduate Student in Music Education.
MUED 441. Philosophical Foundations of Music Education. 3 Units.
In this course, students explore major aesthetic philosophies that have influenced contemporary music education, and discuss current issues central to our field. Among topics included: basic views about art/music; creating art/music; meaning in art/music, experiencing art/music; music and aesthetic education; criticism in music; multicultural music; and critical theories and inquiry regarding music education. Students are asked to assess their own roles in music education, as well as their obligations and potential capacities for leadership in the profession. Students will work toward development of a personal professional philosophy of music education.

MUED 442. Curriculum and Assessment in Music Education. 3 Units.
This course is designed to give graduate music education students thorough knowledge of the overarching role of curriculum and assessment as the organizational elements of instruction. In depth coverage of such topics as: the role of assessment and measurement in teaching; epistemology; scope and sequence; backward design; instructional goals; validity; reliability; performance assessments; measuring assessment; curriculum design; and teaching for understanding. These concepts and procedures will be explored in depth to give daily music instruction a global framework in the larger organizational structure of profession, state, national, and accreditation standards for P-12 and college music settings.

MUED 443. Music Cognition and Learning. 3 Units.
Survey and critical review of the literature as it relates to music teaching and learning, and music performance. Specific topics may include basic psychoacoustical processes, auditory perception, cognitive organization of musical sound, tonal and musical memory, neuromusical research, affective and physiological responses to music, learning theory, musical aptitude, developmental processes, and motivation.

MUED 444. Informal Music Learning in Education. 3 Units.
This course explores the tenets of informal music making as it relates to teaching school music. Students will learn how to create, compose, improvise, and perform on a variety of folk and traditional instruments. Specific topics of this course include songwriting, cover tunes, original songs, and creative warm-ups for traditional ensembles. This course also is designed to assist students in developing diverse school music offerings through utilizing research tools and resources on creativity, generating project-based learning opportunities for school students, assessing creativity, and fostering critical thinking, all within the contexts of formal and informal modes of music teaching and learning. Prereq: Graduate Student in Music Education or requisites not met permission of instructor.

MUED 445. Pedagogy in Practice. 3 Units.
This course is designed to help students better understand music teaching skills and characteristics of effective teachers, and to critique teaching practices and abilities through an examination of research-based and pedagogy-based scholarship. Students will learn to find, interpret, and use music education research to improve their own classroom pedagogy. Group class meetings will take place on campus, and individual, mentored lab experiences will be held via Skype or in students' schools. Prereq: Graduate Student in Music Education or requisites not met permission of instructor.

MUED 446. Sociology of Music Education. 3 Units.
In this course, students explore philosophical, social, cultural, and theoretical issues regularly encountered by music educators in classroom and rehearsal settings. Topics covered include: local, state, and national issues and policies intersecting with music education; social challenges and classroom realities facing music educators; social and cultural diversity issues in music education; and the role(s) of music education in society. Prereq: MUED 440.

MUED 447. Seminar in College Music Teaching. 3 Units.
Seminar in College Music Teaching is a course to help prepare CWRU and CIM music graduate students for careers in university teaching. This course includes information on creating class syllabi, assessing students, interviewing for college jobs, and understanding the university ecosystem. Coursework will be tailored to meet the needs and goals of each graduate student, regardless of content area. Perspectives will be drawn from music education, applied music, musicology, conducting, music theory, and music technology. Prereq: Graduate music student at CWRU and CIM.

MUED 450. Special Topics in Music Education. 3 Units.
Close study of a theme or aspect of music education, such as brain development in music education, biomechanics and music, gender studies in music education, and gerontology and music learning.

MUED 491. Music in Early Childhood. 3 Units.
The goal of the course is to provide students with an understanding of the role of music in early childhood and approaches to music education with young children. Students will experience an overview of selected theories of musical development of young children, discuss the importance of music to various areas of child development, explore cultural perspectives and influences on musical development, evaluate curricular materials and methods used in early childhood music education, observe children’s music making in early childhood classrooms, and develop teaching skills for early childhood music settings. Topics and content of this course include: music’s role in early childhood development; music aptitude and its measurement; theories of early childhood music learning; early childhood making; evaluating curricular materials for early childhood music; the importance of play in early childhood musical development; incorporating State and National Music Education Standards; designing instruction for early childhood music settings; assessment in early childhood music; cultural perspectives on music in early childhood; cultural influences on musical development; music therapy with young children; benefits of family interaction in music; the role of listening in early childhood musical development; and formal music instruction with young children. The class will participate in a weekly service learning project providing music instruction for young children and parents or caregivers from an underserved population. Offered as MUED 391 and MUED 491.

MUED 496A. Student Teaching in Music Education. 9 Units.
Teaching music in both elementary and secondary schools, full-time five days a week for 15 weeks. Closely supervised field experiences of all types with a wide variety of students. Emphasis on planning lessons and organizing materials, teaching methodologies, motivation, and student assessment. Topics addressed include communications and the arts, technology in learning, interdisciplinary learning, collaborative learning and teaching, creating a supportive environment, and professional development. Development of skills needed for self-assessment as well as student assessment. Clinical/Field experiences (all ages) required. Recommended preparation: Concurrent enrollment in MUED 396B. Offered as MUED 396A and MUED 496A. Counts as SAGES Senior Capstone. Prereq: EDUC 255.
MUED 496B. Student Teaching Seminar in Music Education. 3 Units. 
This is the SAGES Senior Capstone requirement for students majoring in Music Education. Taken at the same time as the student teaching experience (MUED 396A/496A), this seminar will guide students through preparation for entering the professional world of music education, and mentor them in their preparation of their Senior Capstone Project and Presentation. Recommended preparation: Concurrent enrollment in MUED 496A. Offered as MUED 396B and MUED 496B. Counts as SAGES Senior Capstone.

MUED 501. Special Reading (M.A. and M.M.). 1 - 18 Units.
MUED 544. Advanced Research in Music Education. 3 Units.
Advanced studies in models and methods of music education research. Research projects using data analysis. In-depth examination of selected quantitative and/or qualitative research designs according to student interests. Discussion of thesis and dissertation proposal format process. Recommended preparation: MUED 444.

MUED 556. Graduate Chamber Ensemble. 1 Unit.
This course is intended for graduate music education students who desire to perform at a high level. The purposes of this course are to give students the opportunity to further their technical and musical development through the performance of chamber music repertoire; work collaboratively with colleagues in the preparation of this repertoire by functioning as both performer and coach; foster score study and repertoire research by planning each program, writing program notes, and running the performance; and work with other chamber groups and evaluate their performances and assist them with their preparation.

MUED 590. Seminar in Music Education. 3 Units.
This seminar is designed for music education doctoral students to pursue advanced research methodologies and procedures. Topics might include meta-analysis, multiple regression, advanced qualitative coding, and mixed methods research.

MUED 591. Music Education Seminar in Conducting. 3 Units.
In this course, students focus on advanced score study, preparation, and analysis. In depth conducting techniques on contemporary music and mixed meter compositions, along with the development of a comprehensive conducting bibliography are the major components in this seminar. Historical research, analytical evaluation, and the practical elements of the physical techniques required for one to conduct a chosen composition are all addressed for each composition studies. Seminar discussions include aesthetic and philosophical ideologies, and the practical issues a conductor faces when put in control of the advanced ensemble.

MUED 640. Qualitative Research in Music Education. 3 Units.
This course provides music education graduate students with an in-depth look at qualitative research techniques in educational settings, along with an emphasis on design and analysis, and a critical review of selected research studies in music education. The goals of this class include gaining an understanding of the qualitative research paradigm, learning to write effectively and efficiently as a qualitative researcher, and conducting a small-scale qualitative research project. Prereq: Graduate Music Education major and MUED 440 or requisites not met permission.

MUED 641. Quantitative Research Methods in Music Education. 3 Units.
Effective educators of all levels are expected to continually refine their knowledge of how students best learn music in practical applications through assimilation of current research. Implementation of research findings in one’s classroom, as well as contributions back to the profession through scholarship, should remain a priority. Quantitative Research Methods will explore fundamentals of research design and appropriate statistical methods for interpretation of data. Specific topics will include: identification of research issues, selection of appropriate experimental designs for investigation, application of statistical methods for data interpretation, and evaluation of available research. Effective and efficient skills in writing and presentation will be expected and reinforced in all course activities. Prereq: MUED 440.

MUED 651. Thesis (M.A. and M.M.). 1 - 6 Units.
MUED 696. College Teaching Practicum. 0 Unit.
MUED 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

MUEN Courses
MUEN 324. Case Percussion Ensemble. 0 - 2 Units.
The Case Percussion Ensemble is open to all interested Case-affiliated individuals who seek to continue their musical development by performing percussion ensemble literature. Membership is contingent on an audition that demonstrates moderate percussion ability and the ability to read music. Audition materials can be acquired through the director. Recommended preparation: Audition required. Coreq: MUEN 383.

MUEN 355. Miscellaneous Ensembles. 0 - 2 Units.
MUEN 356. University Circle Wind Ensemble. 1 Unit.
Designed for the most advanced woodwind, brass, and percussion players. Stresses the single-performance concept utilizing only players needed for a given piece. Audition required.

MUEN 365. Case Chamber Music. 0 - 1 Units.
This course will utilize wind instruments in different combinations, performing chamber music dating from the Renaissance to the 21st Century. The creation of new works and the adaptations of other repertoire will also be encouraged for unique/non-standard instrumentations. All combinations of Woodwinds, Brass, Voice, Strings, Guitar, Harp, Percussion, and Keyboard instruments will be considered; repertoire will be determined by available instrumentation. Membership is contingent on an audition that demonstrates moderate proficiency and the ability to read music. Audition materials can be acquired through the director. Coreq: MUEN 383 or MUEN 385 or MUEN 386.

MUEN 370. Popular Music Ensemble. 0 - 1 Units.
The Popular Music Ensemble at Case Western rehearses and performs a wide range of non-jazz popular music styles. Repertoire is usually suggested by students and chosen in collaboration with the instructor. Current popular music of the United States has tended to be favored, but the ensemble has also worked on music that originated as much as several decades ago. The group’s instrumentation is typically drums, bass, guitars, keyboard, and a number of vocalists. Occasionally original material is brought into the repertoire.

MUEN 373. Jazz Ensemble I. 0 - 1 Units.
Recommended preparation: Audition required.
MUEN 374. Jazz Ensemble II. 0 - 1 Units.
MUEN 382. Case Concert Choir. 0 - 1 Units.
Case Concert Choir is open to any undergraduate or graduate student by audition. The ensemble performs both a cappella and accompanied choral music from a variety of time periods and genres. Concert Choir members have the opportunity to perform choral-orchestral repertoire through collaborations with the Case University Circle Orchestra and our other University Circle neighbors. The ensemble maintains a tradition of excellence in performance, strives to improve group and individual musicianship skills, and fosters community building. Recommended preparation: Audition required.

MUEN 383. Symphonic Winds. 0 - 1 Units.
Performance of advanced symphonic band repertoire. Open to all Case students, faculty and staff. Audition required for part placement only.

MUEN 384. Spartan Marching Band. 0 - 1 Units.

MUEN 385. Case/University Circle Orchestra. 0 - 1 Units.
The orchestra is comprised of Case students, faculty, staff and community players who play strings, woodwinds, brass and percussion. Recommended preparation: Audition required.

MUEN 386. Case Camerata Chamber Orchestra. 0 - 1 Units.
This chamber string ensemble is open to all interested Case affiliated individuals who seek to continue their music development by performing orchestral literature. Each person is required to audition to determine initial placement, section assignment, and seating. All members are required to perform a minimum of 2 concerts per academic year. Recommended preparation: Audition required.

MUEN 387. University Singers. 0 - 1 Units.
University Singers is open to all students enrolled in the University who enjoy singing. The ensemble performs a wide variety of accompanied and a cappella repertoire. The ability to read music is not required for participation and no audition is necessary. Students must be able to match pitch and can expect to sing for the conductor to determine their appropriate vocal parts. Goals of the University Singers include developing basic musicianship skills, learning to sing safely and efficiently, and enjoying sharing music with fellow singers and the community.

MUEN 389. Keyboard Ensemble. 0 - 1 Units.
Keyboard Ensemble is designed for music majors whose primary instrument is piano. The format involves coaching of in-class performances of solo literature, piano duets, and collaborative piano genres by enrolled students, as well as written and spoken presentations focusing on keyboard history, literature, and performance critique. The course meets once per week. It is highly recommended that students be concurrently enrolled in applied lessons. Non-majors who are pianists and majors whose primary instrument is not piano may enroll with instructor permission following a successful audition.

MUEN 393. Baroque Chamber Ensembles. 0 - 1 Units.
Designed for students interested in exploring baroque music in a chamber setting on historical instruments. Prereq: Audition required.

MUEN 394. Baroque Dance Ensemble. 0 - 1 Units.
This course allows musicians and dancers alike to explore historical dance steps and notation. History of dance and its relationships to music will be emphasized as students learn and perform historical dances. Prereq: MUHI 342 or MUHI 442 or permission of Instructor.

MUEN 395. Collegium Musicum. 0 - 1 Units.
Recommended preparation: Audition required.

MUEN 396. Early Music Singers. 0 - 1 Units.
Recommended preparation: Audition required.

MUEN 397. Baroque Orchestra. 0 - 1 Units.
Recommended preparation: Audition required.

MUEN 398. Cleveland Orchestra Chorus. 0 - 1 Units.
Recommended preparation: Audition required.

MUGN Courses

MUGN 201. Introduction to Music: Listening Experience I. 3 Units.
A flexible approach to the study of the materials and literature of music. Aural and analytical skills primarily for classical music.

MUGN 212. History of Rock and Roll. 3 Units.
This course surveys the musical practices of the rock and roll era, broadly defined to include much popular music since the 1950s. Music majors are to enroll in MUHI 312. Counts for CAS Global & Cultural Diversity Requirement. Prereq: For Non-Music Majors only.

MUGN 215. History and Styles of Jazz. 3 Units.

MUGN 220. Composers of the Musical on Stage and Screen. 3 Units.
This course is meant to provide students with an introduction to the role of music in the history, reception, and popularity of the Broadway and Hollywood musical, with a particular focus on the creators—the composers, lyricists, and orchestrators. We will survey the early history, going back to 19th century experiments, revues, and the origins of the "book" musical, going through the golden age of the 1930s to the 1950s, the nadir of output in the 1960s and 1970s (Oh, Calcutta, anyone?), the revival in the 1980s with the rise of the megamusical, all the way to today's rock-music driven puppet extravaganzas. Classes will also discuss ever-shifting genres and styles of music, new approaches to songwriting, and changes to what qualifies as "acceptable" music. There's also the structure of the stories to consider, as well as gender roles, racial stereotypes, ethnic under/overtones, and camp.

MUGN 250. Topics in Music for non-majors. 3 Units.
Close study of a theme, a work, or aspect of music such as "Music and Gender," "Music in Vienna," or "Instruments of Music." The course is intended as an exploration of diverse aspects of music in society, both historical and modern, and is primarily for non-majors as a follow-up to MUGN 201 or MUGN 202.

MUGN 308. Digital Music: Composition and Production. 3 Units.
Course focuses on digital music creation and composition using audio sequencing software. Topics include song writing, synthesizers, recording, editing, mixing, and film scoring. Course is open to music majors, minors, and non-majors with sufficient musical background. Emphasis on group work, creativity, and imagination. All work done on Macintosh computers in The Core, the Department of Music's multimedia classroom.

MUGN 309. Audio Production in Pro Tools. 3 Units.
Audio Production in Pro Tools. Practical training in contemporary audio production methods using the industry standard software, Pro Tools. Also covers the use of Pro Tools for musical analysis and evaluation of music copyright issues.

MUGN 399. Undergraduate Independent Studies. 1 - 3 Units.
Each student develops a topic of interest to be explored with a faculty member.
MUHI 501. Special Reading (M.A. and M.M.). 1 - 18 Units.
MUHN 651. Thesis. (M.A. and M.M.). 1 - 6 Units.
MUHN 751. Recital Document I-D.M.A.. 1 - 3 Units.
MUHN 752. Recital Document II - D.M.A.. 1 - 3 Units.

MUHI Courses
MUHI 201. History of Western Music I. 3 Units.
A survey of Western music from the earliest notations to c1800. Prereq: MUTH 102 or MUTH 104 or MUTH 108.
MUHI 202. History of Western Music II. 3 Units.
A survey of Western music from c1800 to the present. Prereq: MUHI 201.
MUHI 301. History of Western Music I. 3 Units.
Developments in Western music from early Christian times to c1700. Prereq: MUTH 102 or MUTH 104 or (Prereq or Coreq) MUTH 108.
MUHI 302. History of Western Music II. 3 Units.
Developments in Western music from c1700 to c1900. Prereq: MUTH 102 or MUTH 104 or MUTH 108.
MUHI 303. History of Western Music III. 3 Units.
Music of the twentieth century, covering history, analysis, and aesthetic issues. Prereq: MUTH 102 or MUTH 104 or MUTH 108, MUHI 301 or MUHI 302.
MUHI 309. Christian Music: Historical and Global Perspectives. 3 Units.
Music has played an outsized role in the history and development of Christianity, from plainchant to polyphony, shape note singing to gospel, congregational hymns to contemporary genres and global musical expressions at Christian worship across different continents and cultures. Offered as an upper-division seminar for advanced undergraduate and graduate students, this seminar examines the history and development of Christian music around the world within the social, cultural, regional, ritual, and spiritual contexts that inspired their emergence and growth. While the primary approach in this seminar is historiographical, ethnomusicological principles may be utilized where appropriate to examine contemporary genres of Christian music from the Two-Thirds or Majority World. Offered as RLGN 318, RLGN 418, and MUHI 309. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.
MUHI 312. History and Analysis of Rock and Roll. 3 Units.
This course surveys American popular song from the 1890s to the present, with an emphasis on rock ‘n’ roll and pop music of the last sixty years. The relationship of popular song to important currents in American life and culture will be examined. The origins of various styles of song in the cultures of different ethnic and national groups will be discussed, along with the subsequent diffusion and transformation of such music through mass mediation. The characteristics and meanings of music, lyrics, and images will be discussed with the aid of sound recordings, music videos and films. Students taking this course may not receive credit for MUHN 212. Counts for CAS Global & Cultural Diversity Requirement. Prereq: For Music Majors only.
MUHI 313. American Popular Song to 1950. 3 Units.
Survey of popular music practices from the nineteenth century until the emergence of rock and roll. Counts for CAS Global & Cultural Diversity Requirement.
MUHI 314. Blues Histories and Cultures. 3 Units.
An investigation of the blues as a musical and lyrical form as well as a set of social and cultural practices. Beginning in the Mississippi Delta with the country blues, the course moves roughly chronologically, looking at classic and urban blues, the role of blues language and culture during the Harlem Renaissance, and their ‘revival’ in Britain in the 1960s. Our aim will be to open up questions surrounding blues transformations and black authenticities, the relationship between blues cultures and the rise of modernism, the racial and sexual coding of both black and white blues, and the ways in which blues sounds and aesthetics have permeated American popular music since the 1920s. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.
MUHI 315. History of Jazz and American Popular Music. 3 Units.
MUHI 316. The Lemonade Class: Religion, Race, Sex and Black Music. 3 Units.
Charles Long suggests that black musical forms are creative responses to the particular circumstances of black peoples’ presence in the U.S and black notions of the sacred. In April of 2016, Beyoncé released her visual album Lemonade two days after the death of Prince. This course is organized around the album’s title cuts and links these two artists together in an examination of religion and musical performance as creative response to the racial and gendered conditions of black life. The course investigates how both artists have used music as a platform to explore issues of race, gender, commerce, sexuality, power and divinity. The course also looks at examples from the works of earlier artists who address similar themes such as Ma Rainey, Bessie Smith, Muddy Waters, Billie Holiday, Nina Simone, Little Richard, James Brown, Marvin Gaye, and Aretha Franklin. Offered as ETHS 302, MUHI 316, RLGN 302, RLGN 402, and WGST 302. Counts for CAS Global & Cultural Diversity Requirement.
MUHI 320. Global Pop. 3 Units.
Exploration of popular music practices, particularly rock, pop, and hip hop, outside the United States. Counts for CAS Global & Cultural Diversity Requirement.
MUHI 326. The Holocaust and the Arts. 3 Units.
This course explores artistic output during the Holocaust, as well as responses to the Holocaust in various forms, including music, art, architecture, film, and literature. Offered as MUHI 326, JDST 326, HSTY 326 and RLGN 326 Counts for CAS Global & Cultural Diversity Requirement.
MUHI 341. Introduction to Historical Performance Practice. 3 Units.
Summary and perspective of the problems and issues associated with the field of historical performance practices. Offered as MUHI 341 and MUHI 441. Prereq: MUHI 301 and MUHI 302.
MUHI 342. Seminar in Historical Performance Practice. 3 Units.
Seminar in a specific instrument and/or vocal area of historical performance practices, such as baroque vocal, instrumental, or keyboard practices. May be repeated because topics vary. Offered as MUHI 342 and MUHI 442. Prereq: MUHI 341 or MUHI 441
MUHI 350. Topics in Music History. 3 Units.
Close study of a theme or aspect of music such as "Music and Gender," "Symphonies of Mahler," and "Wagner's Ring." Offered as MUHI 350 and MUHI 450.
MUHI 390. Undergraduate Seminar in Music History. 3 Units.
An intensive research seminar in music history for music majors. Counts as SAGES Departmental Seminar.

MUHI 395A. Capstone for Music Majors A. 1 Unit.
Not required for the music major, but intended for music majors in concentrations other than Audio Recording who choose to complete a capstone project in music. Course consists of projects varying according to the students' area of study and interests, but each must include a document of appropriate length and scope and must be presented publicly in an appropriate forum. MUHI 395A guides students through the preliminary stages of the project and preparation of a formal Capstone proposal. Counts as SAGES Senior Capstone. Prereq: Successful completion of MUHI 201 and MUHI 202.

MUHI 395B. Capstone for Music Majors B. 2 - 5 Units.
Not required for the music major, but intended for music majors in concentrations other than Audio Recording who choose to complete a capstone project in music. Course consists of projects varying according to students' area of study and interests, but each must include a document of appropriate length and scope and must be presented publicly in an appropriate forum. MUHI 395B guides students through completion of the project, including the document and public presentation. Counts as SAGES Senior Capstone. Prereq: Successful completion of MUHI 395A.

MUHI 399. Undergraduate Independent Studies. 1 - 3 Units.
Each student develops a topic of interest to be explored with a faculty member.

MUHI 401. Methodologies of Music History. 3 Units.
Introduction to the scholarly study of music, including principles of music bibliography, techniques of library research, and evaluation of editions. Special emphasis given to the relationship between musical performance and research in the history and criticism of music. Attention will also be given to design of program notes and essays. Required of first-year students in the Master of Music degree program.

MUHI 430. Music History for Educators. 3 Units.
Examines the intersections of composers' musical output as it overlaps with theories of general education, music education, and pedagogy.

MUHI 431. Medieval Music: Early Christian to 1425. 3 Units.
The mass, liturgical drama, and early polyphony through the Ars Nova.

MUHI 432. Music of the Renaissance. 3 Units.
Vocal polyphonic music from the Burgundian school through the Elizabethan madrigal.

MUHI 433. Music of the Baroque. 3 Units.
Musical developments from Monteverdi to Bach and Handel.

MUHI 434. Viennese Classicism. 3 Units.
Development of the symphony, concerto, chamber music, and opera in the works of the Mannheim composers, Haydn, Mozart, and Beethoven.

MUHI 435. Nineteenth Century Music. 3 Units.
Romanticism and other 19th century trends in music up to impressionism.

MUHI 436. Twentieth Century Music. 3 Units.
Critical and analytical study of music since 1900. Examination and discussion of stylistic characteristics and aesthetic aims of contemporary composers.

MUHI 437. Popular Music Studies. 3 Units.
Introduction to the interdisciplinary field of popular music studies, with emphasis on musicological approaches. Analysis of musical signification within the complex cultural contexts shaped by place, history, commerce, and technology.

MUHI 441. Introduction to Historical Performance Practice. 3 Units.
Summary and perspective of the problems and issues associated with the field of historical performance practices. Offered as MUHI 341 and MUHI 441.

MUHI 442. Seminar in Historical Performance Practice. 3 Units.
Seminar in a specific instrument and/or vocal area of historical performance practices, such as baroque vocal, instrumental, or keyboard practices. May be repeated because topics vary. Offered as MUHI 342 and MUHI 442. Prereq: MUHI 341 or MUHI 441

MUHI 443. Medieval/Renaissance Notation. 3 Units.
Theory of chant, modal, mensural, and tablature notations. Practice in making literal transcriptions, editing, and preparing scores for performances.

MUHI 450. Topics in Music History. 3 Units.
Close study of a theme or aspect of music such as "Music and Gender," "Symphonies of Mahler," and "Wagner's Ring." Offered as MUHI 350 and MUHI 450.

MUHI 501. Special Reading (M.A. and M.M.). 1 - 18 Units.

MUHI 590. Seminar in Musicology. 3 Units.
Problems in musical criticism, aesthetics, and analysis, as well as interdisciplinary methodologies.

MUHI 601. Special Readings Ph.D./D.M.A.. 1 - 18 Units.

MUHI 610. Bibliography and Research Methods in Music. 3 Units.
Seminar in research methods and techniques, stressing the analytic and functional approaches to bibliography.

MUHI 611. Doctor of Musical Arts Seminar. 3 Units.
Recommended preparation: MUHI 610.

MUHI 612. Analysis for Music Historians. 3 Units.
This seminar will be required of all first-year graduate students in Musicology and Historical Performance Practices. It seeks to develop the analytical skills of music historians, deepening their earlier technical training and teaching them how to approach repertoires (music before 1700, after 1900, popular music) they are unlikely to have studied in depth previously. In contrast to the instruction offered at CIM, this seminar will present a range of ways in which to bridge between the details of a musical composition and the historical context within which it first appeared. The seminar deals with five case studies, each representative of each of the following repertoires: Before 1700 (e.g., Josquin motets, Monteverdi madrigals, Frescobaldi toccatas) 1700-1820 (e.g., Rameau keyboard suites, Beethoven sonatas, Schubert string quartets) 1820-1910 (e.g., Berlioz Symphonie Fantastique, Brahms symphonies, Mahler songs) After 1910 (e.g., Stravinsky Sacre du Printemps, Webern Symphony, Ruth Crawford Seeger String Quartet, Ligeti Etudes) Popular Music (e.g. 12-bar blues, "rhythm changes," "Round Midnights") Of these, most students will have received training only in the analysis of music 1700-1820, and that training will have concentrated strictly on harmony and structure, without engagement with cultural context. Each unit of this seminar will proceed from basic grammatical norms for the repertory in question to formal criticism to cultural interpretation.
MUHI 651. Thesis (M.A. and M.M.). 1 - 6 Units.

MUHI 699. Qualifying Exam Practicum. 0 Unit.
This class is meant to guide students as they prepare their bibliographies and works lists (if applicable) for their qualifying exams. We will discuss how best to address the broad topics they have chosen for their exams, and the manner in which they can begin to focus their research to an achievable list, one that they will craft with input from their exam committee. Beginning with the key works in their areas, they will be shown how best to expand the list to include current literature, and how to prioritize what should and should not be on the list.

MUHI 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

MUHI 710. Dissertation Seminar. 0 Unit.
This class is meant to give students a place to deal with writing their dissertation: discussion, critique, complaints, and questions are all an accepted and expected part of the process. Once during the semester students will provide the group with a chapter (or part of a chapter, or conference paper), which they will read. The group will discuss the work as a group, giving everyone a chance to provide suggestions, corrections, and other forms of critique. Everyone will get a chance to present their own work and will get many chances to read the work of others. Exposure to different topics and writing styles will not only broaden students' approach to their own work, but will also prepare them for the multiplicity of research and writing styles they'll face on the job market and in the academy.

MUHI 751. Recital Document I - D.M.A.. 1 - 3 Units.

MUHI 753. Recital Document III-D.M.A.. 1 - 6 Units.

MUPD Courses

MUPD 399. Undergraduate Independent Studies. 1 - 3 Units.
Each student develops a topic of interest to be explored with a faculty member.

MUPD 501. Special Reading (M.A. and M.M.). 1 - 18 Units.

MUTH Courses

MUTH 101. Harmony-Keyboard I. 2 Units.
Scales, intervals, triads, seventh chords, and their inversions. Harmonization of melodies and basses, chorale study, modulation, analysis. Creative use of material. Correlated and taken concurrently with MUTH 105 and MUTH 106. Both aspects of the course must be passed in order to complete requirements.

MUTH 102. Harmony-Keyboard II. 2 Units.
(See MUTH 101.)

MUTH 103. Theory I. 3 Units.
Music theory for the nonmusic major. Intervals, scales, rhythmic drill, sight singing, eartraining, keyboard work, and harmony through inversions of triads and seventh chords. Not open to music majors.

MUTH 104. Theory II. 3 Units.
(See MUTH 103.) Recommended preparation: MUTH 103 or consent of department.

MUTH 105. Sightsinging-Eartraining I. 2 Units.
Aural and vocal study of isolated and contextual rhythmic patterns, scales, intervals, triads, seventh chords, and traditional and contemporary songs in treble and bass clefs. Correlated and taken concurrently with MUTH 101 and MUTH 102. Both aspects of the course must be passed in order to complete requirements.

MUTH 106. Sightsinging-Eartraining II. 2 Units.
(See MUTH 105.)

MUTH 107. Theory for Music Majors I. 4 Units.
This course is the first of four semesters of music theory requirements for Case music majors. It will include the study of harmony, analysis, eartraining, and keyboard skills. Recommended preparation: Placement exam through department.

MUTH 108. Theory for Music Majors II. 4 Units.
This course is the second of four semesters of music theory for Case music majors. It includes further study of harmony, analysis, eartraining, sightsinging, and keyboard. Recommended preparation: MUTH 107 or placement exam through department.

MUTH 201. Harmony-Keyboard III. 2 Units.
Continuation of MUTH 101 and MUTH 102. Chromatically altered triads and 7th chords; 9th, 11th, 13th. Neapolitan and augmented 6th chords, regular and irregular solutions. Correlated and taken concurrently with MUTH 205 and MUTH 206. Both aspects of the course must be passed in order to complete requirements. Students cannot earn credit for both MUTH 201/205 and MUTH 207. Recommended preparation: MUTH 102 or placement examination.

MUTH 202. Harmony-Keyboard IV. 4 Units.
(See MUTH 201.) Recommended preparation: MUTH 102 or placement examination.

MUTH 205. Sightsinging-Eartraining III. 2 Units.
Aural and vocal study using alto and tenor clefs, in addition to treble and bass. Correlated and taken concurrently with MUTH 201 and MUTH 202. Both aspects of the course must be passed in order to complete requirements. Students cannot earn credit for both MUTH 201/205 and MUTH 207. Recommended preparation: MUTH 106 or placement examination.

MUTH 207. Theory for Music Majors III. 4 Units.
This course is the third of four semesters of music theory for music majors. Continued study of harmony, analysis, eartraining, sightsinging, and keyboard, including use of dissonance and chromaticism, diatonic modulation. Students cannot earn credit for both MUTH 201/205 and MUTH 207. Recommended preparation: MUTH 108 or placement exam through department.

MUTH 208. Theory for Music Majors IV. 4 Units.
This course is the fourth of four semesters of music theory for CWRU music majors. Continued study of harmony, analysis, ear-training, sight-singing, and keyboard. Use of dissonance and chromaticism, chromatic voice leading technique, tonal and post-tonal topics. Recommended preparation: MUTH 207 or placement exam through department.

MUTH 311. 16th Century Counterpoint. 2 Units.
Sixteenth century modal counterpoint. Exercises in the five species. Writing of short compositions and motets in two, three and four voices. Recommended preparation: MUTH 202 or MUTH 206.

MUTH 312. Eighteenth Century Counterpoint. 3 Units.
Analysis and writing of inventions in two parts, and fugues in three and four parts. Recommended preparation: MUTH 202 or MUTH 206.

MUTH 319. Jazz Skills. 3 Units.
This class is designed to teach students basic skills in jazz improvisation, jazz keyboard, arranging/composition and pedagogy. Basic theory is required. Students will eventually arrange their own composition for big band, which will feature them as the improvising soloist. Prereq: (MUTH 102 and MUTH 106) or MUTH 108 or permission of instructor.
MUTH 320. Form and Analysis. 3 Units.
Aural and visual analysis of structural and stylistic features of 16th through 20th century music. Prereq: MUTH 202 or MUTH 208.

MUTH 399. Undergraduate Independent Studies. 1 - 3 Units.
Each student develops a topic of interest to be explored with a faculty member.

MUTH 400A. Review of Musical Structure. 3 Units.
Instruction of fundamentals of form, counterpoint, and four-part harmony. Designed for graduate students; credit not applicable toward degree requirements.

MUTH 400B. Sightsinging and Eartraining Review. 2 Units.
Background in fundamentals of sight singing in four clefs; melodic and harmonic dictation including chromatic harmony and modulation. Designed for graduate students; credit not applicable toward degree requirements.

MUTH 416. Pre-common Practice Theory and Analysis. 3 Units.
An exploration of treatises and analytical methods appropriate to music of the Medieval and Renaissance eras.

MUTH 422. Musical Analysis for Educators. 3 Units.
Musical Analysis for Educators is designed to strengthen the analysis skills of music educators and explore practical application of these skills. Recommended preparation: Placement exam.

MUTH 424. Introduction to Schenkerian Analysis. 3 Units.

MUTH 461. Theory Pedagogy. 3 Units.
Principles of the teaching of theory at all levels, with examination and appraisal of teaching methods, textbooks, recent concepts, etc.

MUTH 495. Seminar in Music Theory. 3 Units.

MUTH 501. Special Reading (M.A. and M.M.). 1 - 18 Units.

Natural Sciences Program

112 AW Smith Bldg
www.case.edu/artsci/natsci
Phone: 216.368.3989
Peter Whiting, Program Advisor
peter.whiting@case.edu

The natural sciences major is an interdepartmental science program that leads to the Bachelor of Arts (BA) degree. It is intended to serve students whose interests and objectives call for a major in the humanities or social sciences (e.g., the major in history and philosophy of science) that is best accompanied by a broad background in the natural sciences.

Undergraduate Programs

Major
Natural sciences is available as a second major for the BA; the first major must be in a department or program within the arts, humanities, or social sciences, excluding the programs in Environmental Studies, Gerontological Studies, and Pre-Architecture. For a student who completes a BS degree in management or accounting, natural sciences may serve as the sole major for the BA degree.

The program requires a minimum of 50 semester hours of work in natural sciences and mathematics. The departments included in the major are astronomy; biology; chemistry; earth, environmental, and planetary sciences; and physics. The student must complete a minimum of 20 hours in one of these departments, a minimum of 8 hours each in two of the other departments, and 3 hours each in the remaining two departments. In addition, all natural sciences majors must complete:

One of the following sequences:

<table>
<thead>
<tr>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

The courses used to satisfy the natural sciences major should be courses that would satisfy requirements of an existing science major. However, any 200-level or higher astronomy course is acceptable for the natural sciences major.

Minor

A minor is achieved through completion of the requirements listed below in any four of the six participating departments.

Astronomy

One of the following sequences:

<table>
<thead>
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Biology

Two of the following sequences:

<table>
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<tr>
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<tr>
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</table>

Chemistry

One of the following sequences:

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>8-10</td>
</tr>
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</table>
Earth, Environmental, and Planetary Sciences

One of the following: 3
- EEPS 101 The Earth and Planets 3
- EEPS 110 Physical Geology 3
- EEPS 115 Introduction to Oceanography 3
- EEPS 117 Weather and Climate 3
- EEPS 119 Geology Laboratory 1

One additional EEPS course 3

Total Units 19

Mathematics

One of the following sequences: 8
- MATH 125 & MATH 126 Math and Calculus Applications for Life, Managerial, and Social Sci I and Math and Calculus Applications for Life, Managerial, and Social Sci II
- MATH 121 & MATH 122 Calculus for Science and Engineering I and Calculus for Science and Engineering II

Total Units 8

Physics

One of the following sequences: 8-11
- PHYS 115 & PHYS 116 Introductory Physics I and Introductory Physics II
- PHYS 121 & PHYS 122 General Physics I - Mechanics and General Physics II - Electricity
- PHYS 221 and Introduction to Modern Physics

Total Units 8-11

Nutrition

The College of Arts and Sciences awards the Bachelor of Arts and Bachelor of Science degrees in nutrition. The required courses for the majors and minors are offered by the Department of Nutrition in the School of Medicine.

Undergraduate Degrees (NTRN)

Major Programs

The undergraduate degree in nutrition is appropriate for students who wish to:

1. pursue graduate programs in nutritional biochemistry, dietetics, public health and community nutrition or other biomedical sciences
2. enter professional schools of dentistry, medicine, physical therapy, or pharmacy
3. apply to dietetic internships or approved experience programs in order to prepare for the professional practice of dietetics
4. pursue careers with the government or in the food or pharmaceutical industry

This major offers flexibility in course selection within a framework of general program requirements. The selection of courses depends on the student’s choice of emphasis. Students wishing to qualify for admission to professional or graduate programs need to include specific courses considered prerequisites for admission. Students interested in applying to dietetic internships must meet specific course requirements (Didactic Program in Dietetics) as required by the Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and Dietetics. These requirements are met in the courses that comprise the Didactic Program in Dietetics (DPD). The DPD at Case Western Reserve University is currently granted Accreditation by the Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and Dietetics, 120 South Riverside Plaza, Suite 2000, Chicago, IL 60606-6995, 800.877.1600. A department advisor should be consulted in the freshman year to plan the dietetics coursework.

Human Nutrition

Bachelor of Science degree requires:

Required Courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tr>
<td>NTRN 201</td>
<td>Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 342</td>
<td>Food Science</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 342L</td>
<td>Food Science Lab</td>
<td>2</td>
</tr>
<tr>
<td>NTRN 343</td>
<td>Dietary Patterns</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 363</td>
<td>Human Nutrition I: Energy, Protein, Minerals</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 364</td>
<td>Human Nutrition II: Vitamins</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 397</td>
<td>SAGES Capstone Proposal Seminar</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 398</td>
<td>SAGES Senior Capstone Experience</td>
<td>3</td>
</tr>
</tbody>
</table>

Three nutrition electives chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTRN 328</td>
<td>Child Nutrition, Development and Health</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 341</td>
<td>Food as Medicine: How what we eat influences how we feel, think, and our health status</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 351</td>
<td>Food Service Systems Management</td>
<td></td>
</tr>
<tr>
<td>NTRN 359</td>
<td>Diabetes Prevention and Management</td>
<td></td>
</tr>
<tr>
<td>NTRN 360</td>
<td>Clinical Assessment and Diagnosis: Nutritional, Functional, Physical</td>
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</tr>
<tr>
<td>NTRN 361</td>
<td>Energy Dysregulation: From Obesity to Anorexia</td>
<td></td>
</tr>
<tr>
<td>NTRN 362</td>
<td>Exercise Physiology and Macronutrient Metabolism</td>
<td></td>
</tr>
<tr>
<td>NTRN 365</td>
<td>Nutrition for the Prevention and Management of Disease: Pathophysiology</td>
<td></td>
</tr>
<tr>
<td>NTRN 366</td>
<td>Nutrition for the Prevention and Management of Disease: Clinical Applications</td>
<td></td>
</tr>
<tr>
<td>NTRN 367</td>
<td>Nutrition Strategies and Wellness Programming</td>
<td></td>
</tr>
<tr>
<td>NTRN 371</td>
<td>Special Problems *</td>
<td></td>
</tr>
<tr>
<td>NTRN 388</td>
<td>Seminar in Sports Nutrition</td>
<td></td>
</tr>
<tr>
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<td>Undergraduate Research *</td>
<td></td>
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<tr>
<td>NTRN 435</td>
<td>Nutrition during Pregnancy and Lactation</td>
<td></td>
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<tr>
<td>NTRN 436</td>
<td>Pediatric Nutrition</td>
<td></td>
</tr>
<tr>
<td>NTRN 437</td>
<td>Evaluation of Nutrition Information for Consumers</td>
<td></td>
</tr>
<tr>
<td>NTRN 438</td>
<td>Dietary Supplements</td>
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</table>
### Bachelor of Science in Nutrition - Human Nutrition Major Example Plan of Study

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTRN 439</td>
<td>Food Behavior: Physiological, Psychological and Environmental Determinants</td>
<td></td>
</tr>
<tr>
<td>NTRN 440</td>
<td>Nutrition for the Aging and Aged</td>
<td></td>
</tr>
<tr>
<td>NTRN 452</td>
<td>Nutritional Biochemistry and Metabolism</td>
<td></td>
</tr>
<tr>
<td>NTRN 550A</td>
<td>Advanced Community Nutrition or NTRN 528 Introduction to Public Health Nutrition</td>
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**Additional Required Courses:**

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<tr>
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<th>Course Title</th>
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<tbody>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
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<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I (before NTRN 363)</td>
<td>3</td>
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<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
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<tr>
<td>BIOL 216</td>
<td>Development and Physiology</td>
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<tr>
<td>BIOL 216L</td>
<td>Development and Physiology Lab</td>
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<td>BIOL 340</td>
<td>Human Physiology</td>
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<tr>
<td>BIOL 346</td>
<td>Human Anatomy</td>
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<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>4</td>
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One of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>ANTH 319</td>
<td>Introduction to Statistical Analysis in the Social Sciences</td>
<td>3</td>
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<tr>
<td>PSCL 282</td>
<td>Quantitative Methods in Psychology</td>
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<tr>
<td>STAT 201</td>
<td>Basic Statistics for Social and Life Sciences</td>
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<tr>
<td>PQHS 431</td>
<td>Statistical Methods I</td>
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</table>

**Total Units:** 49

* Only one of these courses is permitted.
400 level courses require instructor consent for undergraduates to enroll.

### Bachelor of Arts degree requires:

**Required Courses:**

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<td>NTRN 343</td>
<td>Dietary Patterns</td>
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<td>3</td>
</tr>
<tr>
<td>NTRN 397</td>
<td>SAGES Capstone Proposal Seminar</td>
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<tr>
<td>NTRN 398</td>
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</table>

Two nutrition electives chosen from the following: 6

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
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<tr>
<td>NTRN 550A</td>
<td>Advanced Community Nutrition or NTRN 528 Introduction to Public Health Nutrition</td>
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</table>

**Total Units:** 49

* Only one of these courses is permitted.
400 level courses require instructor consent for undergraduates to enroll.
Principles of Chemistry II (CHEM 106)  3
Principles of Chemistry Laboratory (CHEM 113)  2
SAGES Breadth Requirements  9

Year Total:  13  14

Second Year

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<thead>
<tr>
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<tr>
<td>NTRN Electives</td>
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<tr>
<td>Introductory Organic Chemistry I (CHEM 223)</td>
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<td>SAGES University Seminar</td>
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<td>Development and Physiology (BIOL 216)</td>
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<td>Development and Physiology Lab (BIOL 216L)</td>
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<tr>
<td>SAGES University Seminar</td>
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<td>Basic Statistics for Social and Life Sciences (STAT 201)</td>
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<tr>
<td>Electives</td>
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<tr>
<td>Dietary Patterns (NTRN 343)</td>
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<td>Year Total:</td>
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Third Year

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<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 307)</td>
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<td>SAGES Breadth Requirements</td>
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<tr>
<td>Food Science (NTRN 342)</td>
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<td>Food Science Lab (NTRN 342L)</td>
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<tr>
<td>Nutrition Elective</td>
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<tr>
<td>Elective</td>
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Fourth Year

<table>
<thead>
<tr>
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<th>Spring</th>
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<tbody>
<tr>
<td>SAGES Senior Capstone Experience (NTRN 398)</td>
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<tr>
<td>Electives</td>
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<tr>
<td>Human Nutrition I: Energy, Protein, Minerals (NTRN 363)</td>
<td>3</td>
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<tr>
<td>Human Nutrition II: Vitamins (NTRN 364)</td>
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<tr>
<td>Nutrition Elective</td>
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<td>Electives</td>
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<td>Year Total:</td>
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Total Units in Sequence:  77

Nutritional Biochemistry and Metabolism

Bachelor of Arts degree requires:

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<th>Units</th>
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<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>NTRN 364</td>
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<td></td>
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<tr>
<td>NTRN 397</td>
<td>3</td>
<td></td>
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<tr>
<td>NTRN 398</td>
<td>3</td>
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<tr>
<td>NTRN 452</td>
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One nutrition elective at 300-level (or above with instructor consent)  3

Additional required courses:

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<th>Units</th>
<th>Fall</th>
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<tbody>
<tr>
<td>MATH 125</td>
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<tr>
<td>or MATH 121</td>
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Bachelor of Science degree requires:

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<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>NTRN 201</td>
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<tr>
<td>NTRN 342</td>
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<tr>
<td>NTRN 342L</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>NTRN 363</td>
<td>3</td>
<td></td>
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<tr>
<td>NTRN 364</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>NTRN 397</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>NTRN 398</td>
<td>3</td>
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</tbody>
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Total Units:  118
NTRN 452  Nutritional Biochemistry and Metabolism  3

One nutrition elective at 300-level (or above with instructor consent)  3

Additional required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 124</td>
<td>Calculus II</td>
<td></td>
</tr>
<tr>
<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>or MATH 227</td>
<td>Calculus III</td>
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<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
<td>3</td>
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<tr>
<td>or MATH 228</td>
<td>Differential Equations</td>
<td></td>
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<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>or CHEM 323</td>
<td>Organic Chemistry I</td>
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<tr>
<td>CHEM 224</td>
<td>Introductory Organic Chemistry II</td>
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<td>or CHEM 324</td>
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<td>CHEM 233</td>
<td>Introductory Organic Chemistry Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 234</td>
<td>Introductory Organic Chemistry Laboratory II</td>
<td>2</td>
</tr>
<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
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</tr>
<tr>
<td>BIOL 215</td>
<td>Cells and Proteins</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 216</td>
<td>Development and Physiology</td>
<td>3</td>
</tr>
<tr>
<td>or BIOL 340 &amp; BIOL 346</td>
<td>Human Physiology and Human Anatomy</td>
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<tr>
<td>BIOL 216L</td>
<td>Development and Physiology Lab</td>
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<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
<td>4</td>
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<tr>
<td>or PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td></td>
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<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
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<tr>
<td>or PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
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<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
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<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>4</td>
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<tr>
<td>BIOC 334</td>
<td>Structural Biology</td>
<td>3</td>
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<tr>
<td>or BIOC 312</td>
<td>Proteins and Enzymes</td>
<td></td>
</tr>
<tr>
<td>or NTRN 454</td>
<td>Advanced Nutrition and Metabolism: Investigative Methods</td>
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<tr>
<td>One of the following</td>
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<tr>
<td>STAT 201</td>
<td>Basic Statistics for Social and Life Sciences</td>
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<tr>
<td>STAT 243</td>
<td>Statistical Theory with Application I</td>
<td></td>
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<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
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<td>STAT 313</td>
<td>Statistics for Experimenters</td>
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Bachelor of Arts in Nutrition - Nutritional Biochemistry and Metabolism Major Example Plan of Study

<table>
<thead>
<tr>
<th>Year</th>
<th>First Year</th>
<th>Units</th>
<th>Second Year</th>
<th>Units</th>
<th>Third Year</th>
<th>Units</th>
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<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
<td>Spring</td>
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<td>Total Units</td>
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First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I (MATH 125)</td>
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<td>Nutrition (NTRN 201)</td>
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<tr>
<td>Genes, Evolution and Ecology (BIOL 214)</td>
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<tr>
<td>SAGES First Seminar</td>
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<td>Principles of Chemistry I (CHEM 105)</td>
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<tr>
<td>SAGES Breadth Requirements</td>
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<tr>
<td>Cells and Proteins (BIOL 215)</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Chemistry Laboratory (CHEM 113)</td>
<td>2</td>
</tr>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II (MATH 126)</td>
<td>4</td>
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<tr>
<td>Principles of Chemistry II (CHEM 106)</td>
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Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Introductory Organic Chemistry Laboratory I (CHEM 233)</td>
<td>2</td>
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<tr>
<td>Introductory Organic Chemistry I (CHEM 223)</td>
<td>3</td>
</tr>
<tr>
<td>Development and Physiology (BIOL 216)</td>
<td>4</td>
</tr>
<tr>
<td>SAGES University Seminar</td>
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<tr>
<td>Electives</td>
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<tr>
<td>Introductory Organic Chemistry II (CHEM 224)</td>
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<tr>
<td>Introductory Organic Chemistry Laboratory II (CHEM 234)</td>
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<tr>
<td>Nutrition Elective</td>
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<td>Elective</td>
<td>3</td>
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<tr>
<td>SAGES University Seminar</td>
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Third Year

<table>
<thead>
<tr>
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<th>Spring</th>
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<tbody>
<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 307)</td>
<td>4</td>
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<tr>
<td>Introductory Physics I (PHYS 115)</td>
<td>4</td>
</tr>
<tr>
<td>Food Science (NTRN 342)</td>
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</tr>
<tr>
<td>Food Science Lab (NTRN 342L)</td>
<td>2</td>
</tr>
<tr>
<td>SAGES Capstone Proposal Seminar (NTRN 397)</td>
<td>3</td>
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<tr>
<td>Elective</td>
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<tr>
<td>Introductory Physics II (PHYS 116)</td>
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<td>SAGES Breadth Requirement</td>
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### Fourth Year

<table>
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<tr>
<td><strong>SAGES Senior Capstone Experience (NTRN 398)</strong></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Nutritional Biochemistry and Metabolism (NTRN 452)</strong></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Human Nutrition I: Energy, Protein, Minerals (NTRN 363)</strong></td>
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<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Nutrition Elective (if not already taken)</strong></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Human Nutrition II: Vitamins (NTRN 364)</strong></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Structural Biology (BIOC 334)</strong></td>
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<tr>
<td>Elective</td>
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<td><strong>Year Total:</strong></td>
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**Total Units in Sequence:** 114

### Minor in Nutrition

Nutrition majors are not eligible for this minor. Non Nutrition majors may only take one minor: either Minor in Nutrition or Minor in Sports Nutrition.

**Required courses:**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTRN 201</td>
<td>Nutrition</td>
</tr>
<tr>
<td>NTRN 328</td>
<td>Child Nutrition, Development and Health</td>
</tr>
<tr>
<td>NTRN 342</td>
<td>Food Science</td>
</tr>
<tr>
<td>NTRN 343</td>
<td>Dietary Patterns</td>
</tr>
<tr>
<td>Three credits selected from:</td>
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</tr>
<tr>
<td>NTRN 351</td>
<td>Food Service Systems Management</td>
</tr>
<tr>
<td>NTRN 361</td>
<td>Energy Dysregulation: From Obesity to Anorexia</td>
</tr>
<tr>
<td>NTRN 363</td>
<td>Human Nutrition I: Energy, Protein, Minerals</td>
</tr>
<tr>
<td>NTRN 364</td>
<td>Human Nutrition II: Vitamins</td>
</tr>
<tr>
<td>NTRN 365</td>
<td>Nutrition for the Prevention and Management of Disease: Pathophysiology</td>
</tr>
<tr>
<td>NTRN 366</td>
<td>Nutrition for the Prevention and Management of Disease: Clinical Applications</td>
</tr>
<tr>
<td>NTRN 388</td>
<td>Seminar in Sports Nutrition</td>
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</tbody>
</table>

**Total Units:** 15

### Minor in Sports Nutrition

Nutrition majors are not eligible for this minor.

**Required courses:**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTRN 201</td>
<td>Nutrition</td>
</tr>
<tr>
<td>NTRN 361</td>
<td>Energy Dysregulation: From Obesity to Anorexia</td>
</tr>
<tr>
<td>NTRN 362</td>
<td>Exercise Physiology and Macronutrient Metabolism</td>
</tr>
<tr>
<td>NTRN 388</td>
<td>Seminar in Sports Nutrition</td>
</tr>
<tr>
<td>One Nutrition elective at the 300 level</td>
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</tbody>
</table>

**Total Units:** 15

### Didactic Program in Dietetics (DPD)

The following courses must be included in the program.

**Required courses:**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTRN 201</td>
<td>Nutrition</td>
</tr>
<tr>
<td>NTRN 342</td>
<td>Food Science</td>
</tr>
<tr>
<td>NTRN 342L</td>
<td>Food Science Lab</td>
</tr>
<tr>
<td>NTRN 343</td>
<td>Dietary Patterns</td>
</tr>
<tr>
<td>NTRN 351</td>
<td>Food Service Systems Management</td>
</tr>
<tr>
<td>NTRN 360</td>
<td>Clinical Assessment and Diagnosis: Nutritional, Functional, Physical</td>
</tr>
<tr>
<td>NTRN 363</td>
<td>Human Nutrition I: Energy, Protein, Minerals</td>
</tr>
<tr>
<td>NTRN 364</td>
<td>Human Nutrition II: Vitamins</td>
</tr>
<tr>
<td>NTRN 365</td>
<td>Nutrition for the Prevention and Management of Disease: Pathophysiology</td>
</tr>
<tr>
<td>NTRN 366</td>
<td>Nutrition for the Prevention and Management of Disease: Clinical Applications</td>
</tr>
<tr>
<td>NTRN 550A</td>
<td>Advanced Community Nutrition (or NTRN 528)</td>
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<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
</tr>
<tr>
<td>BIOL 216</td>
<td>Development and Physiology</td>
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<tr>
<td>BIOL 343</td>
<td>Microbiology</td>
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<tr>
<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
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<tr>
<td>ENGL 150</td>
<td>Expository Writing (or SAGES Writing Portfolio)</td>
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<tr>
<td>SOCI 101</td>
<td>Introduction to Sociology</td>
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<td>One of the following:</td>
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<tr>
<td>EDUC 304</td>
<td>Educational Psychology</td>
</tr>
<tr>
<td>PSCL 353</td>
<td>Psychology of Learning</td>
</tr>
<tr>
<td>PSCL 357</td>
<td>Cognitive Psychology</td>
</tr>
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<td>One of the following:</td>
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<tr>
<td>ANTH 215</td>
<td>Health, Culture, and Disease: An Introduction to Medical Anthropology</td>
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<tr>
<td>SOCI 311</td>
<td>Health, Illness, and Social Behavior</td>
</tr>
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<td>One of the following:</td>
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<tr>
<td>ANTH 319</td>
<td>Introduction to Statistical Analysis in the Social Sciences</td>
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<tr>
<td>PSCL 282</td>
<td>Quantitative Methods in Psychology</td>
</tr>
<tr>
<td>STAT 201</td>
<td>Basic Statistics for Social and Life Sciences</td>
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<tr>
<td>PQHS 431</td>
<td>Statistical Methods I</td>
</tr>
<tr>
<td>STAT 243</td>
<td>Statistical Theory with Application I</td>
</tr>
<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
</tr>
<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
</tr>
</tbody>
</table>

**Total Units:** 61

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**Origins Sciences Program**

217 Rockefeller, Institute for the Science of Origins
The Origins Sciences Program offers the Bachelor of Arts degree. The major provides a rigorous course of study with great flexibility in the choice of specific topics and courses. Students play a creative role in designing their own individual educational plans within the major. As a result, they are free to explore nontraditional, multidisciplinary and transdisciplinary subjects.

The Origins Sciences major is designed to connect students with professors breaking through barriers to ask big questions in ways that matter, both at the highest theoretical levels and also with immediate practical applications in areas such as medicine and technology. Its concerns range from the nanoscale to ecological relationships to galaxies to dark matter, dark energy and the nature of the universe itself. The major’s sponsor, the Institute for the Science of Origins (http://origins.case.edu) (ISO), brings together scientists from Case Western Reserve University, (http://www.case.edu) the Cleveland Museum of Natural History (https://www.cmnh.org) and other partner institutions to answer questions about the origin and evolution of simple and complex systems, from the big bang to the human mind.

The curriculum emphasizes a broad grounding in the origins sciences, including fundamentals of physics, biology, chemistry and mathematics, and encompassing aspects of anthropology, cognitive science, astronomy and earth, environmental and planetary sciences, making it reasonable for students to consider a double or secondary major or a dual degree. A faculty actively engaged in research in these fields and beyond provides first-rate instruction and opportunities for undergraduate involvement in cutting-edge research, including laboratory and museum experience and fieldwork across the globe.

An undergraduate degree in Origins Sciences can be tailored to meet the needs of pre-med or other pre-health students, or to prepare students for graduate programs in any of the allied disciplines, including anthropology, astronomy, biology, chemistry, cognitive science, geosciences, applied mathematics, paleontology and physics.

Majoring in Origins Sciences gives students added value in applying to medical school, graduate school or the increasingly technical science-related MBA and JD programs. The major also provides a strong background for students interested in pursuing careers in science writing; internships are available at ideastream, ISO’s public TV and radio partner institution.

**Major**

Origins Sciences is a primary major, but may also be pursued in conjunction with a more traditional disciplinary major. Up to 12 credits in required and elective courses taken by students for their other major may be applied to their Origins Sciences major.

The 30-credit interdisciplinary major in Origins Sciences consists of:

1. Science Core
2. Origins Core
3. Origins Foci

Within the Origins foci, each student will design a curriculum that includes concentrations in at least two Origins Sciences fields, such as:

- Cosmology and astrophysics
- Integrative evolutionary biology (e.g., biochemistry, physical anthropology, paleontology, and evolutionary cognitive science)
- Planetary science and astrobiology

In consultation with a major advisor, students create their individual plans of study to suit their own particular interests within the major. A typical student will develop a proposal as a sophomore and submit that plan for approval by the Origins Sciences Major Advisory Committee. Each concentration must include at least two 300 or higher level classes and their prerequisites. Subsequent revisions to the plan are encouraged when appropriate, but must be submitted for approval by the committee at least two weeks before the beginning of the semester preceding the one in which the revisions take effect. Students are strongly encouraged to include an Origins Sciences research experience in their educational plans.

**Science Core:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL 214</td>
<td>Genes, Evolution and Ecology</td>
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<td>BIOL 214L</td>
<td>Genes, Evolution and Ecology Lab</td>
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<tr>
<td>BIOL 225</td>
<td>Evolution</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
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**Origins Core:**

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<th>Course Title</th>
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<tbody>
<tr>
<td>ORIG 101</td>
<td>Origins Prologue: Life, the Universe, and Everything (Optional)</td>
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<tr>
<td>ORIG 201</td>
<td>Origins I: From the Beginning</td>
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</tr>
<tr>
<td>ORIG 202</td>
<td>Origins II: Life in all its diversity</td>
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<tr>
<td>ORIG 301</td>
<td>Mathematical Modeling Across the Sciences</td>
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<tr>
<td>ORIG 351</td>
<td>Topics in Origins (Must be taken twice)</td>
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**Sample First Year Schedule**

**Freshman**

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<th>Units</th>
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<tr>
<td>1</td>
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<tr>
<td>3</td>
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</table>

Origins Prologue: Life, the Universe, and Everything (ORIG 101)

Genes, Evolution and Ecology (BIOL 214)  (or PHYS or CHEM)  

Genes, Evolution and Ecology Lab (BIOL 214L)
Calculus for Science and Engineering I (MATH 121) (or MATH 125) | 4
Humanities Elective | 3
SAGES First Seminar | 4
PHED Elective | 0
Year Total: | 16

Total Units in Sequence: 16

Freshman

<table>
<thead>
<tr>
<th>Units</th>
<th>Spring</th>
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<tbody>
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<td>Origins I: From the Beginning (ORIG 201)</td>
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</tr>
<tr>
<td>Evolution (BIOL 225)</td>
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</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122) (or MATH 126)</td>
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<td>Humanities or Global/Cultural Elective</td>
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<td>SAGES University Seminar</td>
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<td>PHED Elective</td>
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<td>Year Total:</td>
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</tbody>
</table>

Total Units in Sequence: 16

Program Faculty

Patricia Princehouse, PhD
Director, Origins Sciences Program; Director, Program in Evolutionary Biology; Outreach Director, Institute for the Science of Origins;

Glenn Starkman, PhD
Distinguished University Professor, Department of Physics; Director, Institute for the Science of Origins; Director, Center for Education and Research in Cosmology and Astrophysics (CERCA)

Cynthia Beall, PhD
Distinguished University Professor and Sarah Idell Pyle Professor of Anthropology; Co-Director, Center for Research on Tibet

Daniela Calvetti, PhD
James Wood Williamson Professor, Department of Mathematics, Applied Mathematics, and Statistics

Darin Croft, PhD
Associate Professor, Department of Anatomy, School of Medicine

Christopher A. Cullis, PhD
Francis Hobart Herrick Professor of Biology

Michael Decker, PhD
Associate Professor, Frances Payne Bolton School of Nursing

Neil S. Greenspan, MD PhD
Professor, Department of Pathology, School of Medicine

Mark Griswold, PhD
Professor, School of Medicine

Yohannes Haile-Selassie, PhD
Curator of Physical Anthropology, Cleveland Museum of Natural History

Ralph Harvey, PhD
Professor, Department of Earth, Environmental, and Planetary Sciences

Joseph LaManna, PhD
Jeanne M. and Joseph S. Silber Professor, Department of Physiology and Biophysics, School of Medicine

Harsh Mathur, PhD
Professor, Department of Physics

J. Christopher Mihos, PhD
Professor, Department of Astronomy

John E. Ruhl, PhD
Connecticut Professor, Department of Physics

Scott W. Simpson, PhD
Professor, Department of Anatomy, School of Medicine

Erkki Somersalo, PhD
Professor, Department of Mathematics, Applied Mathematics, and Statistics

Giuseppe Strangi, PhD
Professor and Ohio Research Scholar in Surfaces of Advanced Materials, Department of Physics

Kingman P. Strohl, MD
Professor, School of Medicine

Wanda Strychalski, PhD
Assistant Professor, Department of Mathematics, Applied Mathematics, and Statistics

James Van Orman, PhD
Professor, Department of Earth, Environmental, and Planetary Sciences

Michael Weiss, PhD
Cowan-Blum Professor, Department of Biochemistry, School of Medicine

Mark A. Willis, PhD
Professor, Department of Biology

Courses

ORIG 101. Origins Prologue: Life, the Universe, and Everything. 1 Unit.
This one-credit course introduces students to the research interests of Origins faculty, and thereby to some of the possibilities for student research or focused study. Topics range across cosmology, astronomy, planetary sciences, astrobiology, evolutionary biology, evolutionary cognitive science, anthropology, and evolutionary medicine.

ORIG 201. Origins I: From the Beginning. 3 Units.
A three credit quantitative introduction to cosmology, astrophysics, planetary science and geology in which they are connected through the narrative of origins setting the stage for the development of life on Earth. Prereq: PHYS 121 or PHYS 123.

ORIG 202. Origins II: Life in all its diversity. 3 Units.
An integrated introduction to the origins sciences including aspects of evolutionary biology, ecology, paleontology, physical anthropology and cognitive science. The course will generally meet at the Cleveland Museum of Natural History. Prereq: BIOL 214.
ORIG 301. Mathematical Modeling Across the Sciences. 3 Units.
A three credit course on mathematical modeling as it applies to the origins sciences. Students gain practical experience in a wide range of techniques for modeling research questions in cosmology and astrophysics, integrative evolutionary biology (including physical anthropology, ecology, paleontology, and evolutionary cognitive science), and planetary science and astrobiology. Offered as ORIG 301, ORIG 401 and MATH 357. Prereq: ORIG 201, ORIG 202, BIOL 225, MATH 122, CHEM 106 and (PHYS 122 or PHYS 124).

ORIG 351. Topics in Origins. 3 Units.
A three-credit special topics course in any Origins discipline or interdisciplinary combination. Instruction may take place on campus or at partner institutions such as the Cleveland Museum of Natural History, and may at times include fieldwork. Offered as ORIG 351 and ORIG 451. Prereq: ORIG 201, ORIG 202, ORIG 301.

ORIG 360. Independent Study in Origins. 1 - 3 Units.
A 1-3 credit offering available on an ad hoc basis to students wishing to pursue in depth study in an appropriate origins topic under the supervision of a willing faculty member. Prereq: ORIG 201, ORIG 202.

ORIG 370. Research in Origins. 1 - 6 Units.
A 1-6 credit offering available on an ad hoc basis to students wishing to pursue independent research in an origins topic under the supervision of a willing faculty member. Offered as ORIG 370 and ORIG 470. Prereq: ORIG 201, ORIG 202, ORIG 301.

ORIG 401. Mathematical Modeling Across the Sciences. 3 Units.
A three credit course on mathematical modeling as it applies to the origins sciences. Students gain practical experience in a wide range of techniques for modeling research questions in cosmology and astrophysics, integrative evolutionary biology (including physical anthropology, ecology, paleontology, and evolutionary cognitive science), and planetary science and astrobiology. Offered as ORIG 301, ORIG 401 and MATH 357. Prereq: ORIG 201, ORIG 202, BIOL 225, MATH 122, CHEM 106 and (PHYS 122 or PHYS 124).

ORIG 451. Topics in Origins. 3 Units.
A three-credit special topics course in any Origins discipline or interdisciplinary combination. Instruction may take place on campus or at partner institutions such as the Cleveland Museum of Natural History, and may at times include fieldwork. Offered as ORIG 351 and ORIG 451. Prereq: ORIG 201, ORIG 202, ORIG 301.

ORIG 470. Research in Origins. 1 - 6 Units.
A 1-6 credit offering available on an ad hoc basis to students wishing to pursue independent research in an origins topic under the supervision of a willing faculty member. Offered as ORIG 370 and ORIG 470. Prereq: ORIG 201, ORIG 202, ORIG 301.

ORIG 485. Comparative & Evolutionary Physiology. 4 Units.
This course presents physiological concepts from the comparative and evolutionary perspective. Aspects of vertebrate and mammalian evolution will be considered with respect to the generation of adaptive advantages for organisms to changing environmental challenges since the Cambrian. Comparative physiological concepts include scaling, variations in nutrition, energy metabolism and work efficiency. The important influences of time, temperature, water and energy on mammalian biology will be presented. The course is a lecture based course that can be taken in person or on-line. Evaluations will be by regular quizzes, a mid-term and a final exam, all MCQ. Offered as PHOL 485 and ORIG 485.

Department of Philosophy
203 Clark Hall

www.case.edu/artsci/phil
Phone: 216.368.2810; Fax: 216.368.0814
Laura Hengehold, Department Chair
laura.hengehold@case.edu

The Department of Philosophy offers an undergraduate major leading to the Bachelor of Arts degree. It also offers minor programs for undergraduates as well as graduate-level courses for candidates for the Master of Arts degree in such fields as biomedical ethics, history, English, mathematics, and the sciences.

The department’s course offerings are designed not only to provide knowledge and skills required for students whose main interest is in philosophy, but also to educate students in general about the intellectual issues that a reflective person is likely to encounter in various contexts of civilized life. The department emphasizes the relevance of philosophy to mathematics, computer science, the natural sciences, the social sciences, the humanities and arts, and law.

The major program in philosophy, besides offering a solid foundation for advanced study in philosophy and enriching programs in other disciplines, develops the skills for analytical and critical thinking, effective communication, and rational decision making needed in a wide range of endeavors. The program thus provides majors with unusual flexibility in the choice of subsequent careers, including law, medicine, and management, while complementing the pursuit of career objectives with a greater perspective and a richer quality of intellectual life.

In collaboration with the Department of History, the department participates in an interdisciplinary major in the History and Philosophy of Science Program (p. 377), leading to the Bachelor of Arts degree. The department also participates in, and contributes courses to, the interdisciplinary minor in artificial intelligence.

Undergraduate Programs
Major
The major consists of 30 hours (ten 3-credit courses) in philosophy, including PHIL 101 Introduction to Philosophy, PHIL 201 Introduction to Logic, PHIL 301 Ancient Philosophy, PHIL 302 Modern Philosophy, and six other elective philosophy courses to be determined in consultation with the department’s undergraduate advisor. However, a student may request permission to take up to 6 hours (two 3-credit courses) of the required 18 hours of philosophy electives in another field or other fields. Such a request should be supported by considerations showing how the substitution(s) would strengthen the student’s major in philosophy. The advisor must approve the substitution(s) in advance.

Major Required Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tr>
<td>PHIL 101</td>
<td>Introduction to Philosophy</td>
<td>3</td>
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<tr>
<td>PHIL 201</td>
<td>Introduction to Logic</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 301</td>
<td>Ancient Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 302</td>
<td>Modern Philosophy</td>
<td>3</td>
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</table>

Six philosophy electives chosen in consultation with advisor. With permission of advisor, up to 6 hours may be taken outside the department. Only 3 units are permitted to be from a University Seminar. Please contact the department for a current list of University Seminars that may be taken for credit towards the major.

| Total Units | 30 |

Laura Hengehold, Department Chair
Departmental Honors

The department offers an honors program for students pursuing a major in philosophy. Students in this program must complete a substantial thesis, pass an oral examination on the thesis, and maintain a B average in philosophy courses. To be eligible for admission, a student should have an overall grade point average of B or better, and a grade of B or better in each philosophy course already taken. A student normally should have taken at least four, and at most seven, philosophy courses at the time of application for admission. An honors student should register for PHIL 399 Philosophy Honors Thesis to do honors work. Interested students should apply for admission to the program during the first semester of junior year. The honors thesis counts for capstone credit as well.

Minor in Philosophy

The department offers a range of possible minor programs, each of which must include PHIL 101 Introduction to Philosophy and four other courses in philosophy at the 200 or 300 level (excluding PHIL 390 Senior Research Seminars in History and Philosophy of Science), to meet the specific needs of students majoring in other fields. The undergraduate advisor will assist students in devising minor programs.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>PHIL 101 Introduction to Philosophy</th>
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</thead>
<tbody>
<tr>
<td>Four philosophy electives chosen in consultation with advisor</td>
<td></td>
<td>12</td>
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<tr>
<td>Total Units</td>
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<td>15</td>
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Minor in Ethics

The minor in ethics allows undergraduate students in any field to pursue a concentration of studies in ethics from multiple perspectives: theoretical and practical, philosophical and empirical/interdisciplinary. The goal is to encourage analytical reflection on the principles and situations of ethical action, social, interpersonal, or individual, in historical and contemporary contexts.

The ethics minor requires a total of 15 credit hours (i.e., five 3-credit hour courses), as follows: PHIL 101 Introduction to Philosophy, PHIL 305 Ethics, two other PHIL courses at the 200-300 level, and one of several identified courses in a field other than philosophy. This represents a modification of the program starting in Fall 2016. Students for whom PHIL 205 Contemporary Moral Problems or PHIL 206 was a requirement prior to Fall 2016 must enter a change in SIS or fill out an Academic Requirements Substitution form in Undergraduate Studies to graduate with the new minor in ethics.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>PHIL 101 Introduction to Philosophy</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td>PHIL 305 Ethics</td>
<td></td>
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<tr>
<td>Two philosophy courses chosen in consultation with advisor</td>
<td></td>
<td></td>
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<tr>
<td>PHIL 205 Contemporary Moral Problems</td>
<td></td>
<td></td>
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<tr>
<td>PHIL 271 Bioethics: Dilemmas</td>
<td></td>
<td></td>
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<td>PHIL 304 Science and Engineering Ethics</td>
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<td>PHIL 311 Neuroethics</td>
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<td></td>
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<tr>
<td>PHIL 315 Selected Topics in Philosophy</td>
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<td></td>
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<tr>
<td>PHIL 317 War and Morality</td>
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<td></td>
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<tr>
<td>PHIL 322 The Science of Happiness</td>
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</tbody>
</table>

| Required Courses | PHIL 330 Topics in Ethics | | PHIL 334 Political and Social Philosophy | | PHIL 356 Comparative Philosophy | | PHIL 371 Advanced Bioethics | | PHIL 375 Issues in Aesthetics | | PHIL 384 Ethics and Public Policy | | PHIL 399 Philosophy Honors Thesis |
|------------------|--------------------------|---|--------------------------------------|---|------------------------|---|--------------------------|---|------------------------|---|
| One course from the following interdisciplinary list: | | |
| PHIL 205 Contemporary Moral Problems | | |
| PHIL 271 Bioethics: Dilemmas | | |
| PHIL 304 Science and Engineering Ethics | | |
| PHIL 311 Neuroethics | | |
| PHIL 315 Selected Topics in Philosophy | | |
| PHIL 317 War and Morality | | |
| PHIL 322 The Science of Happiness | | |

Philosophy Capstone

Students may fulfill their SAGES capstone requirement in philosophy by registering for PHIL 398 Philosophy Capstone after devising a suitable project in consultation with the undergraduate advisor and the supervising faculty member. The honors thesis counts for capstone credit as well.

Master’s Program in Military Ethics

Military ethics is a broadly interdisciplinary study, incorporating concerns about the conduct of war, decisions on how and when to engage in military operations, and issues relating to the moral psychology and care of those who serve and of veterans of military service. It focuses on the core values and moral principles that collectively govern the men and women serving in the military forces of nations around the world, as members of what is sometimes termed the “military profession” or “the profession of arms.” The ethical foundations that define the profession of arms have developed over millennia from the shared values and experiences, unique role responsibilities, and reflections of members of the profession on their own practices—eventually coming to serve as the basis for various warrior codes and the Law of Armed Conflict.
Required Courses

The program has been designed to educate students on and guide their research into vital global issues in military ethics. These issues include (but are not limited to) modern applications of classical just war theory and traditional warrior’s codes, the principle of noncombatant immunity, human rights, international humanitarian law, humanitarian intervention, the ethical use of emerging military technologies, civil-military relations and society’s obligations to troops and veterans, transitional justice, and the moral foundations of sustainable peace.

The study of military ethics supports long-term humanitarian goals, such as preventing unjust wars; decreasing incidents of war crimes, genocide, human rights abuses, and other atrocities produced by the dehumanizing effects of armed conflict; supporting the mental health and successful transitions of military service members and combat veterans; and fostering a lasting peace founded in justice.

Curriculum

The program curriculum is interdisciplinary, with a foundation in moral and political philosophy and international relations. Each student will complete a minimum of 30 credit hours, including a six-credit “capstone course” that will typically be completed during the summer term following a full academic year of course work.

Over a 12- to 15-month program of study (designed to facilitate the enrollment of military personnel on educational assignment and the academic student looking for an intensive program), students will study foundational topics in moral and political philosophy, together with advanced core and elective topics in military and professional ethics, military medical ethics, military law, ethical leadership, and other related subjects (including optional supplemental electives in areas such as religious studies, history, literature, journalism, political science, classics, and the arts).

Required Courses

• PHIL 405 Ethics: This course will build on an existing background in ethical theory and its application. Students will become familiar with major schools of thought and contemporary scholars.

• PHIL 417 War and Morality: The aim of this course is to explore a wide range of ethical issues relating to the decision to take a nation to war, how wars are conducted, and efforts to establish order in the wake of a conflict. This course is presented in a seminar format with lively discussions centering on contemporary readings in military ethics from texts and journals.

• PHIL 430 Topics in Ethics: Military Conflicts, Ethics, and International Law: The aim of this course is to provide a foundational understanding of international law as it relates to war and to explore the relationship between international law and war ethics. This hybrid course will feature video lectures by international experts in the field of military ethics, online assignments, and discussion sections led by the Visiting Inamori Scholar.

• PHIL 484 Ethics and Public Policy: This course focuses on evaluation of ethical arguments in contemporary public policy-making discourse: that is, approaches to evaluating not only the efficiency of policy (Will this policy achieve its end for the least cost?) but also the ethics of policy (Are a policy's intended ends ethically justified or "good," and are our means to achieve those ends moral or "just").

Capstone

When students begin the program, the program director will work with them individually to develop initial concepts for their specific concentrations of study and their capstones. The capstone/culminating project involves both academic research and fieldwork, and is integrated with the degree candidate's professional experience or interest. PHIL 501: Ethics Capstone will feature a summative project designed to integrate their common studies, but tailored to their individual future interests in teaching, further graduate study, or employment in public policy or foreign affairs, and may produce outcomes other than a traditional paper/thesis (such as the detailed and well-defended design of a military ethics training/education curriculum).

The outline of the project will typically be presented and defended by the spring recess of the candidate's second semester in residence, and the project itself completed over the following summer term, for graduation in August the year following matriculation. If special circumstances prevent a student from completing the program in the intended time frame, the academic advisor will work with the student to create an alternative schedule.

Electives

Students will take a minimum of four elective courses. The selection of topic for the capstone project will dictate the selection of relevant elective courses by each student (in consultation with program faculty) to create an appropriate concentration of study. Electives may be in military and professional ethics, military medical ethics, military law, or ethical leadership, or in optional supplemental areas such as religious studies, history, literature, journalism, and the arts.

Elective courses from the College of Arts and Sciences and School of Law include:

• ARTH 436 Representations of War in Ancient Rome
• CLSC 416 Greek Tragedy (in English translation)
• LAWS 4101 International Law
• LAWS 4105 Fundamentals of International Law
• LAWS 5110 Contemporary Issues in International and Comparative Law: IP/Human Rights
• LAWS 5111 Admiralty Law
• LAWS 5113 Counterterrorism Law
• LAWS 5116 International Human Rights
• LAWS 5118 International Law Research Lab
• LAWS 5136 International Humanitarian Law
• PHIL 416 African Political Thought
• PHIL 422 The Science of Happiness
• PHIL 430 Topics in Ethics
• PHIL 434 Political and Social Philosophy
• PHIL 411 Neuroethics
• POSC 460 Revolts and Revolutions in Global Perspective
• POSC 464 Dictatorship and Democracy in Modern Latin America
• POSC 470H China's Foreign Policy
• POSC 473 Politics of the European Union
• POSC 476 United States Foreign Policy
• POSC 479 Introduction to Middle East Politics
• RLGN 453 Hindu and Jain Bioethics
• RLGN 450 Jewish Ethics

Additional elective courses will continue to be added.

Department Faculty

Laura E. Hengehold, PhD
(Loyola University of Chicago)
Associate Professor and Chair
Political and social philosophy; philosophy of feminism; Foucault; contemporary continental philosophy

Jeremy Bendik-Keymer, PhD
(University of Chicago)
Elmer G. Beamer-Hubert H. Schneider Professor in Ethics; Associate Professor
Ethics and moral philosophy; environmental philosophy; philosophy of education; meta-philosophy; history of ethics and moral philosophy

Shannon D. French, PhD
(Brown University)
Inamori Professor of Ethics
Military ethics; leadership ethics; professional ethics; moral psychology; biomedical and environmental ethics

Chris Haufe, PhD
(Columbia University)
Associate Professor
Philosophy of science, philosophy of biology

Anthony Jack, PhD
(University College London, UK)
Associate Professor
Experimental psychology, extensive training in philosophy and neuroscience

Chin-Tai Kim, PhD
(Harvard University)
Professor
History of philosophy (17th, 18th, and 19th centuries); theory of knowledge; metaphysics; foundations of ethics; phenomenology; comparative philosophy

Colin McLarty, PhD
(Case Western Reserve University)
Truman P. Handy Professor of Philosophy
Logic; philosophy of logic; philosophy of mathematics; philosophy of science; contemporary French philosophy

Adjunct Faculty

Joel Levin, DPhil
(University of Oxford, U.K.)
Adjunct Associate Professor; Adjunct Professor, Case Western Reserve University School of Law
Philosophy of law; political philosophy; ethical theory

Secondary Faculty

Insoo Hyun, PhD
(Brown University)
Associate Professor, Department of Bioethics
Bioethics; moral and political philosophy

Deepak Sarma, PhD
(University of Chicago)
Professor, Department of Religious Studies
Hinduism; Indian philosophy; philosophy of religion; method and theory

Courses

PHIL 101. Introduction to Philosophy. 3 Units.
Basic problems of philosophy and methods of philosophical thinking. Problems raised by science, morality, religion, politics, and art. Readings from classical and contemporary philosophers. Normally given in multiple sections with different instructors and possibly with different texts. All sections share core materials in theory of knowledge, metaphysics, and ethics despite differences that may exist in emphasis.

PHIL 201. Introduction to Logic. 3 Units.

PHIL 203. Revolutions in Science. 3 Units.
Historical and philosophical interpretation of some epochal events in development of science. Copernican revolution, Newtonian mechanics, Einstein's relativity physics, quantum mechanics, and evolutionary theory; patterns of scientific growth; structure of scientific "revolutions;" science and "pseudo-science." First half of a year-long sequence. Offered as HSTY 203 and PHIL 203.

PHIL 204. Philosophy of Science. 3 Units.
Conceptual, methodological, and epistemological issues about science: concept formation, explanation, prediction, confirmation, theory construction and status of unobservables; metaphysical presuppositions and implications of science; semantics of scientific language; illustrations from special sciences. Second half of a year-long sequence. Offered as HSTY 207 and PHIL 204.

PHIL 205. Contemporary Moral Problems. 3 Units.
Examination of selected contemporary moral problems and contemporary faces of perennial moral problems such as: when, if ever, lying is justified; the value of honesty and of confidentiality; under what circumstances, if any, various types of killing (suicide, execution, in war, euthanasia, killing of lower animals or ecosystems) are justified. Additional moral problems raised by new knowledge (such as genetic information) or new technology (such as rights to digital information), and responsible uses of these and other sources of power. Clarification of the concepts of value, ethical evaluation and justification, ethical argument, moral relevance, and the notion of a moral problem itself. Readings will draw on classical and contemporary sources in philosophy.
PHIL 221. Indian Philosophy. 3 Units.
We will survey the origins of Indian philosophical thought, with an emphasis on early Buddhist, Hindu and Jain literature. Our concern will be the methods, presuppositions, arguments, and goals of these schools and trajectories of thought. What were their theories on the nature of the person, the nature of reality, and the nature and process of knowing? What were the debates between the schools and the major points of controversy? And, most importantly, are the positions/arguments internally incoherent? Offered as PHIL 221 and RLGN 221. Counts for CAS Global & Cultural Diversity Requirement.

PHIL 225. Evolution. 3 Units.
Multidisciplinary study of the course and processes of organic evolution provides a broad understanding of the evolution of structural and functional diversity, the relationships among organisms and their environments, and the phylogenetic relationships among major groups of organisms. Topics include the genetic basis of micro- and macro-evolutionary change, the concept of adaptation, natural selection, population dynamics, theories of species formation, principles of phylogenetic inference, biogeography, evolutionary rates, evolutionary convergence, homology, Darwinian medicine, and conceptual and philosophic issues in evolutionary theory. Offered as ANTH 225, BIOL 225, EEPS 225, HSTY 225, and PHIL 225.

PHIL 270. Introduction to Gender Studies. 3 Units.
This course introduces women and men students to the methods and concepts of gender studies, women's studies, and feminist theory. An interdisciplinary course, it covers approaches used in literary criticism, history, philosophy, political science, sociology, anthropology, psychology, film studies, cultural studies, art history, and religion. It is the required introductory course for students taking the women's and gender studies major. Offered as ENGL 270, HSTY 270, PHIL 270, RLGN 270, SOCI 201, and WGST 201. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSQ, FSY, FSTS, or FSCS.

PHIL 271. Bioethics: Dilemmas. 3 Units.
We have the genetic technology to change nature and human nature, but should we? We have the medical technology to extend almost any human life, but is this always good? Should we clone humans? Should we allow doctor-assisted suicide for the terminally ill? This course invites students from all academic disciplines and fields to examine current and future issues in bioethics—e.g., theory and methods in bioethics; death and dying; organ transplantation; genetics; aging and dementia; fertility and reproduction; distributive justice in health care access. The course will include guest lecturers from nationally-known Bioethics faculty. Offered as BETH 271 and PHIL 271.

PHIL 301. Ancient Philosophy. 3 Units.
Western philosophy from the early Greeks to the Skeptics. Emphasis on the pre-Socratics, Plato and Aristotle. Recommended preparation: PHIL 101 and consent of department. Offered as CLSC 301 and PHIL 301.

PHIL 302. Modern Philosophy. 3 Units.

PHIL 303. Topics in Philosophy of Science. 3 Units.
In-depth study of selected topics in general philosophy of science or philosophy of physical, biological, or social science. Topics may include: theories of explanation, prediction, and confirmation; semantics of scientific language; reductionism; space, time and relativity; philosophical issues about quantum mechanics; philosophical issues about life sciences (e.g., evolution, teleology, and functional explanation); explanation and understanding in social sciences; value in social science. Recommended preparation: PHIL 101 or PHIL 201 or PHIL 203. Offered as PHIL 303 and PHIL 403.

PHIL 304. Science and Engineering Ethics. 3 Units.
This course prepares students to recognize ethical problems that commonly arise in the scientific and engineering workplace, to understand ethical concepts, to evaluate ethical arguments, and to critically examine responses to problems and their ethical ramifications. It addresses questions such as: What are the criteria of fairness in crediting contributions to research? How safe is safe enough? What are professional responsibilities, and how do they change over time? What is research misconduct? When is ignorance culpable? What is intellectual property and what protections does it deserve? When is biological testing of workers justified? What are responsible ways of raising concerns, and what supports do good organizations give for raising them? What treatment counts as harassment or as an expression of prejudice? What are good means for controlling it? What are scientists' and engineers' responsibilities for environmental protection? What is a "conflict of interest" and how is it controlled? What protections for human research subjects are warranted? What, if any, use of animals in research is justified? Recommended preparation: PHIL 101 or PHIL 205. Offered as PHIL 304 and PHIL 404.

PHIL 305. Ethics. 3 Units.
Analysis of ethical theories and concepts of goodness, right, and obligation. Discussion of nature of justice, problem of justification of moral principles, and relation between facts and values. Recommended preparation: PHIL 101, PHIL 102 or PHIL 205. Offered as PHIL 305 and PHIL 405.

PHIL 306. Mathematical Logic and Model Theory. 3 Units.
Propositional calculus and quantification theory; consistency and completeness theorems; Gödel incompleteness results and their philosophical significance; introduction to basic concepts of model theory; problems of formulation of arguments in philosophy and the sciences. Offered as PHIL 306, MATH 406 and PHIL 406.

PHIL 307. Philosophy of Biology. 3 Units.
This class looks at the philosophical dimensions of various problems in historical and contemporary evolutionary biology. Topics covered include: (1) the theory of natural selection; (2) extinction; (3) human evolution; and (4) higher order evolutionary units and processes. Offered as PHIL 307 and PHIL 407.
PHIL 311. Neuroethics. 3 Units.
Ethics is traditionally a branch of Philosophy. However, research in neuroscience, psychology, and behavioral economics is shedding new light on the underlying bases of ethical behavior and ethical thinking. The class will examine how this work informs and enriches traditional philosophical ethics. Topical focus of the class will depend on student interest, but potentially include: What determines how ethically we behave: our character or our situation? What role do and should emotions play in ethical thinking? Can science tell us whether utilitarian or deontological ethics is better? The dark tetrad: narcissism, Machiavellianism, psychopathy and; sadism. What is empathy and what roles does it play in generating both ethical and unethical behavior. Varieties of moral disengagement, including dehumanizing. Cognitive dissonance and the slide into unethical behavior. Radicalization into violent extremism. Promoting ethical behavior. Offered as PHIL 311 and PHIL 411.

PHIL 313. Philosophy of Mathematics. 3 Units.
Logical paradoxes and their effects on foundations of mathematics. Status of mathematical entities and nature of mathematical truths. Formalist, logicist, and intuitionist positions. Recommended preparation: PHIL 101 or PHIL 201. Offered as PHIL 313 and PHIL 413.

PHIL 315. Selected Topics in Philosophy. 3 Units.
Examination of views of a major philosopher or philosophical school, a significant philosophical topic, or a topic that relates to philosophy and other discipline. Recommended preparation: PHIL 101. Offered as PHIL 315 and PHIL 415. Counts as SAGES Departmental Seminar.

PHIL 316. African Political Thought. 3 Units.
Introduction to select themes in the work of contemporary African philosophers, with special emphasis on political thought. In this course, students will learn something about factors affecting the creation and flow of knowledge and ideas about Africa and discuss the relative importance of the “nation-state” as an idea in Europe, pre-colonial Africa, and post-colonial Africa. Offered as PHIL 316, ETHS 316, PHIL 316, and ETHS 416. Counts for CAS Global & Cultural Diversity Requirement. Prereq: PHIL 101.

PHIL 317. War and Morality. 3 Units.
The aim of this course is to explore a wide range of ethical issues relating to the decision to take a nation to war, how wars are conducted, and efforts to establish order in the wake of a conflict. Topics include the Just War tradition, pacifism, humanitarian intervention, moral repair and the establishment of a just peace, conduct of war, warrior codes, warrior transitions, and civil-military relations. We will be examining the ethics of war from the perspectives of both states and individuals. War is a crucible that strips those caught up in its horrors down to their fundamental selves inspiring acts of both inhuman depravity and seemingly superhuman nobility. This course is presented in a seminar format with lively discussions centering on contemporary readings in military ethics from texts and journals. Offered as PHIL 317, PHIL 417, and LAWS 5135.

PHIL 320. The Phenomenological Tradition. 3 Units.
The background of phenomenology: Descartes, Kant, and Brentano. The epistemological rationale of Husserl’s phenomenology and its ontological implications; the powers and limits of the phenomenological method. Heidegger’s transformation of phenomenology to interpretive ontology of human existence. The development of interpretation theory as the foundation of all human existence. The development of interpretation theory as the foundation of all human sciences in Gadamer and Ricoeur. Recommended preparation: PHIL 101. Offered as PHIL 320 and PHIL 420.

PHIL 322. The Science of Happiness. 3 Units.
Open to all students (no prerequisites) interested in happiness, this course provides an intellectually rigorous introduction to the philosophy and science of happiness. Philosophy is often considered a dry academic subject; however the best philosophy is personal and transforms our view of the world. In recent years, science has made huge strides in understanding the psychology and neuroscience of human happiness. This course blends these two sources of insight to address such critical questions as: What is happiness? To what extent is it determined by our genes? To what extent can we control our own happiness? What factors contribute to an individual’s happiness? Should we be concerned just with our own happiness, or also with the happiness of others? If happiness is a state of mind, can we change our thinking to make ourselves happier? Every self-proclaimed sage, and countless authors of self-help books, claims to know the secret to happiness. This course provides a more intellectually rigorous approach, based on the writings of great philosophers and cutting edge science. Offered as PHIL 322 and PHIL 422.

PHIL 325. Philosophy of Feminism. 3 Units.

PHIL 330. Topics in Ethics. 3 Units.
Examination of views in ethics of a major philosopher or philosophical school, a significant philosophical topic in ethics, or a topic that relates ethics to philosophy and another discipline. Recommended preparation: PHIL 101 or PHIL 205. Offered as PHIL 330 and PHIL 430.

PHIL 333. Philosophy of Religion. 3 Units.
Topics include: classical and contemporary arguments for God’s existence; divine foreknowledge and human freedom; the problem of evil and theodicy; nature and significance of religious experience; mysticism; varieties of religious metaphysics; knowledge, belief and faith; nature of religious discourse. Readings from traditional and contemporary sources. Recommended preparation for PHIL 433 and RLGN 433: PHIL 101 or RLGN 102. Offered as PHIL 333, RLGN 333, PHIL 433, and RLGN 433.

PHIL 334. Political and Social Philosophy. 3 Units.
Justification of social institutions, primarily political ones. Such distinctions as that between de facto and legitimate authority; analysis of criteria for evaluation, such as social justice and equality; inquiry into theories of justification of the state; theory of democratic government and its alternatives. Readings from classical and contemporary sources. Recommended preparation: PHIL 101. Offered as PHIL 334, POSC 354, PHIL 434, and POSC 454.
PHIL 335. Philosophy of Law. 3 Units.
This is an examination of the general nature of law, the broad concerns of jurisprudence, the study of comparative law, and many of the issues raised in the literature of legal philosophy. Students will examine the principles of legal positivism, mitigated natural law, and rights theory. Selected readings and cases will illustrate these theories, which will also be examined in the context of rule selection by new governments in developing or revolutionary societies. The course also looks at the general nature of legal systems: how politics, morality, and individual views of justice and rights affect particular court cases and the course and development of law generally. Topics will include abortion, obscenity and sin, civil disobedience, affirmative action, surrogatehood, and the death penalty. This is unlike any other of the legal theory or jurisprudence courses, and those who have sampled legal theory elsewhere in a different form are welcome and encouraged to enroll. Recommended preparation: PHIL 101. Offered as LAWS 5747, PHIL 335, and PHIL 435.

PHIL 345. Epistemology and Metaphysics. 3 Units.
Traditional problems of epistemology, such as definition of knowledge, justification of belief, nature of evidence and foundationalism, skepticism, the a priori, and the role of sense perception in knowledge. Metaphysical presuppositions and implications of epistemological views. Forms of realism and anti-realism. Recommended preparation: PHIL 101. Offered as PHIL 345 and PHIL 445.

PHIL 355. 19th and Early 20th Century Philosophy. 3 Units.
History of philosophy after Kant up to and including logical empiricism. Interpretation and comparison of important philosophers and philosophical schools of the period in terms of common methods, problems, themes, doctrines, and ideologies. Emphasis on Schopenhauer, Hegel, Kierkegaard, Marx, and Nietzsche. Recommended preparation: PHIL 101. Offered as PHIL 355 and PHIL 455.

PHIL 356. Comparative Philosophy. 3 Units.
Philosophy in the etymological sense of the term, love of wisdom, subsumes ontological, ethical and epistemological inquires addressing fundamental questions about reality, the place of humans in that reality, the values of things and human obligations, and the sources of knowledge. The major purpose of this course is to discover, understand, explicate and articulate the affinities and differences in the way the fundamental questions are addressed in different cultural contexts, thereby to appreciate the cross-cultural kinship among human minds as well as to be challenged by the differences that may engender conflicts. We will explore the possibility of building a trans-cultural meta-cultural meta-discourse in which thinkers from many traditions can participate on equal footing. We will come to face up to the question whether truly universal philosophy is possible, upon what conditions. Representative texts from the Western, Chinese and Buddhist traditions including selected works of Plato, Aristotle, Augustine, Descartes, Kant, Nietzsche, Heidegger, Lao Tzu, Confucius, Chuang Tzu, Dhammapada of the Buddha and D. Suzuki’s Zen Buddhism will be read. Offered as PHIL 356 and PHIL 456. Counts for CAS Global & Cultural Diversity Requirement. Prereq: PHIL 101 or requisites not met permission.

PHIL 360. Science and Society. 3 Units.
This course examines the complex ethical and other value relationships that exist between science and society. Students will be encouraged to question the simplistic view that science proceeds independently of societal values and contentious ethical commitments. A range of other social factors, such as ethical belief systems, political forces, and large-scale financial interests all influence new scientific and technological developments. In order to illuminate each of these larger themes, this course focuses on three exciting areas of scientific inquiry: stem cell research; synthetic biology; and nanotechnology. Each of these contentious scientific fields provides an excellent view into the challenging ethical, cultural, social, political, and economic issues that will face students, both as scholars and as citizens. No prior technical knowledge is necessary for any of these scientific areas. All relevant scientific information will be provided during the course by the professor. Offered as BETH 360, BETH 460 and PHIL 360.

PHIL 366. Brain, Mind and Consciousness: The Science and Philosophy of Mind. 3 Units.
The course introduces students to key topics in philosophy of mind from the perspective of our increasingly advanced scientific understanding of mind and brain (e.g. derived from neuroscience, psychology and cognitive science). Key philosophical topics covered include dualism, physicalism, idealism, consciousness and free will. Key scientific issues covered include methods and assumptions underlying research in psychology and neuroscience, introspection, essentialism, dehumanizing, and work on free will and consciousness. No pre-requisites other than curiosity are required, however students will benefit from having previously taken courses in philosophy, neuroscience, psychology and/or computer science. Students are expected to complete the assigned readings with care and attention, and to participate in discussion. The goal is for students to leave with an understanding of the rich ways in which different approaches can shed light on the human mind, including an appreciation of the limits of scientific inquiry into the mind. Offered as PHIL 366 and PHIL 466.

PHIL 367. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467. Prereq: PHIL 225 or equivalent.

PHIL 368. Evolutionary Biology Capstone. 3 Units.
This course focuses on a special topic of interest in evolutionary biology that will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. Students will participate in discussions and lead class seminars on evolutionary topics and in collaboration with an advisor or advisors, select a topic for a research paper or project. Each student will write a major research report or complete a major project and will make a public presentation of her/his findings. Offered as ANTH 368, BIOL 369, and PHIL 368. Counts as SAGES Senior Capstone.
PHIL 371. Advanced Bioethics. 3 Units.
This course offers upper-level instruction on many key bioethical issues introduced in BETH/PHIL 271. The class follows a discussion-intensive seminar format. Students begin with an in-depth analysis of ethical issues surrounding the conduct of clinical trials, both within the U.S. and through U.S.-sponsored research abroad. Next students examine the philosophical and practical challenges involved in medical decision making for adults and pediatric patients. This course concludes by addressing the broader ethical problem of what duties we owe to future generations in terms of our reproductive choices and the allocation of health-related public expenditures. Each of these general topic areas - clinical trials, medical decision making, and future generations - is of crucial importance for all students whether one plans to enter a career in biomedical research, the healthcare professions, or some other career path. Everyone is a potential patient or the family member of a potential patient. The topics covered in Advanced Bioethics will help prepare students to become responsible participants in an increasingly complex biomedical world. Offered as BETH 371 and PHIL 371. Prereq: BETH 271 or PHIL 271.

PHIL 375. Issues in Aesthetics. 3 Units.
This course will seek to offer insight into the nature of artistic expression, the role of criticism in the arts, and the place of the arts in society. The term "arts" will be construed broadly to include painting, photography, theater, film, music, dance, poetry, etc. The following are examples of questions we will discuss. What does the term "beautiful" mean? Are there other measures of aesthetic value besides beauty? Do the arts, like the sciences, offer us knowledge of the world? What value do the arts have for society? Can aesthetic value conflict with moral value? Do artists have a responsibility to society? Should art ever be censored? What is the relationship between art and entertainment? Is the meaning and value of an artistic work a matter of individual opinion? What is the purpose of art criticism? How are interpretations and evaluations of art influenced by race, gender, class, etc.? What is creativity in the arts? Does it differ from creativity in the sciences? How important is originality in art? Offered as PHIL 375 and PHIL 475. Prereq: PHIL 101 or requisite not met permission.

PHIL 381. Philosophy and Cognitive Neuroscience. 3 Units.
This course will focus on the various methodologies used in the cognitive neurosciences, and explore their strengths and weaknesses from scientific and philosophical standpoints. We will begin by examining baseline measures (including IQ tests, tasks of cognitive flexibility, verbal and visual memory, causal/sequential thinking and narrative tasks) and their experimental design. Lesion methods will follow, with an eye toward understanding the strength of inferences that can be drawn from such data. The course will also focus on imaging techniques (CAT, PET, SPECT, fMRI, TMS, etc.) as well as measures of electrical activity such as EEG and single-cell recordings. Students will become familiar with many fundamental assumptions necessary for the implementation of each method, and philosophical questions associated with these endeavors and their potential impact on our knowledge and society. Recommended preparation: PHIL 101 or COGS 201. Offered as COGS 381 and PHIL 381.

PHIL 384. Ethics and Public Policy. 3 Units.
Evaluation of ethical arguments in contemporary public policymaking discourse. That is, approaches to evaluating not only the efficiency of policy (Will this policy achieve its end for the least cost?) but also the ethics of policy (Are a policy's intended ends ethically justified or "good," and are our means to achieve those ends moral or "just"?). Overview of political ideologies that supply U.S. political actors with their ethical or moral arguments when proposing and implementing public policy, followed by an application of these differing perspectives to selected policy areas such as welfare, euthanasia, school choice, drug laws, censorship, or others. Offered as PHIL 384, PHIL 484, POSC 384 and POSC 484.

PHIL 385. Philosophy of Language. 3 Units.

PHIL 390. Senior Research Seminars in History and Philosophy of Science. 3 Units.
Directed independent research seminar for seniors who are majors in the History and Philosophy of Science program. The goal of the course is to develop and demonstrate command of B.A.-level factual content, methodologies, research strategies, historiography, and theory relevant to the field of history of science and/or philosophy of science. The course includes both written and oral components. Offered as HSTY 380 and PHIL 390. Counts as SAGES Senior Capstone.

PHIL 396. Undergraduate Research in Evolutionary Biology. 3 Units.
Students propose and conduct guided research on an aspect of evolutionary biology. The research will be sponsored and supervised by a member of the CASE faculty or other qualified professional. A written report must be submitted to the Evolutionary Biology Steering Committee before credit is granted. Offered as ANTH 396, BIOL 396, EEPS 396, and PHIL 396.

PHIL 397. Directed Study. 3 Units.
Under faculty supervision, students will undertake a project that demonstrates critical thinking, has clear goals, features periodic reporting of progress, and will result in a final report.

PHIL 398. Philosophy Capstone. 3 Units.
Under faculty supervision, students will undertake a project that demonstrates critical thinking, has clear goals, features periodic reporting of progress, and will result in a final report and public presentation. Counts as SAGES Senior Capstone.

PHIL 399. Philosophy Honors Thesis. 3 Units.
Under faculty supervision, students will complete a substantial thesis that demonstrates critical thinking, has clear goals, features periodic reporting of progress, and will be the subject of an oral examination as well as a public presentation. Counts as SAGES Senior Capstone.

PHIL 403. Topics in Philosophy of Science. 3 Units.
In-depth study of selected topics in general philosophy of science or philosophy of physical, biological, or social science. Topics may include: theories of explanation, prediction, and confirmation; semantics of scientific language; reductionism; space, time and relativity; philosophical issues about quantum mechanics; philosophical issues about life sciences (e.g., evolution, teleology, and functional explanation); explanation and understanding in social sciences; value in social science. Recommended preparation: PHIL 101 or PHIL 201 or PHIL 203. Offered as PHIL 303 and PHIL 403.
PHIL 404. Science and Engineering Ethics. 3 Units.
This course prepares students to recognize ethical problems that commonly arise in the scientific and engineering workplace, to understand ethical concepts, to evaluate ethical arguments, and to critically examine responses to problems and their ethical ramifications. It addresses questions such as: What are the criteria of fairness in crediting contributions to research? How safe is safe enough? What are professional responsibilities, and how do they change over time? What is research misconduct? When is ignorance culpable? What is intellectual property and what protections does it deserve? When is biological testing of workers justified? What are responsible ways of raising concerns, and what supports do good organizations give for raising them? What treatment counts as harassment or as an expression of prejudice? What are good means for controlling it? What are scientists' and engineers' responsibilities for environmental protection? What is a "conflict of interest" and how is it controlled? What protections for human research subjects are warranted? What, if any, use of animals in research is justified? Recommended preparation: PHIL 101 or PHIL 205. Offered as PHIL 304 and PHIL 404.

PHIL 405. Ethics. 3 Units.
Analysis of ethical theories and concepts of goodness, right, and obligation. Discussion of nature of justice, problem of justification of moral principles, and relation between facts and values. Recommended preparation: PHIL 101, PHIL 102 or PHIL 205. Offered as PHIL 305 and PHIL 405.

PHIL 406. Mathematical Logic and Model Theory. 3 Units.
Propositional calculus and quantification theory; consistency and completeness theorems; Gödel incompleteness results and their philosophical significance; introduction to basic concepts of model theory; problems of formulation of arguments in philosophy and the sciences. Offered as PHIL 306, MATH 406 and PHIL 406.

PHIL 407. Philosophy of Biology. 3 Units.
This class looks at the philosophical dimensions of various problems in historical and contemporary evolutionary biology. Topics covered include (1) the theory of natural selection; (2) extinction; (3) human evolution; and (4) higher order evolutionary units and processes. Offered as PHIL 307 and PHIL 407.

PHIL 411. Neuroethics. 3 Units.
Ethics is traditionally a branch of Philosophy. However, research in neuroscience, psychology and behavioral economics is shedding new light on the underlying bases of ethical behavior and ethical thinking. The class will examine how this work informs and enriches traditional philosophical ethics. Topical focus of the class will depend on student interest, but potentially include: What determines how emotionally play in ethical thinking? Can science tell us whether utilitarian or deontological ethics is better? The dark tetrad: narcissism, Machiavellianism, psychopathy and; sadism. What is empathy and what roles does it play in generating both ethical and unethical behavior. Varieties of moral disengagement, including dehumanizing. Cognitive dissonance and the slide into unethical behavior. Radicalization into violent extremism. Promoting ethical behavior. Offered as PHIL 311 and PHIL 411.

PHIL 413. Philosophy of Mathematics. 3 Units.
Logical paradoxes and their effects on foundations of mathematics. Status of mathematical entities and nature of mathematical truths. Formalist, logicist, and intuitionist positions. Recommended preparation: PHIL 101 or PHIL 201. Offered as PHIL 313 and PHIL 413.

PHIL 415. Selected Topics in Philosophy. 3 Units.
Examination of views of a major philosopher or philosophical school, a significant philosophical topic, or a topic that relates to philosophy and other discipline. Recommended preparation: PHIL 101. Offered as PHIL 315 and PHIL 415. Counts as SAGES Departmental Seminar.

PHIL 416. African Political Thought. 3 Units.
Introduction to select themes in the work of contemporary African philosophers, with special emphasis on political thought. In this course, students will learn something about factors affecting the creation and flow of knowledge and ideas about Africa and discuss the relative importance of the "nation-state" as an idea in Europe, pre-colonial Africa, and postcolonial Africa. Offered as PHIL 316, ETHS 316, PHIL 316, and ETHS 416. Counts for CAS Global & Cultural Diversity Requirement.

PHIL 417. War and Morality. 3 Units.
The aim of this course is to explore a wide range of ethical issues relating to the decision to take a nation to war, how wars are conducted, and efforts to establish order in the wake of a conflict. Topics include the Just War tradition, pacifism, humanitarian intervention, moral repair and the establishment of a just peace, conduct of war, warrior codes, warrior transitions, and civil-military relations. We will be examining the ethics of war from the perspectives of both states and individuals. War is a crucible that strips those caught up in its horrors down to their fundamental selves inspiring acts of both inhuman depravity and seemingly superhuman nobility. This course is presented in a seminar format with lively discussions centering on contemporary readings in military ethics from texts and journals. Offered as PHIL 317, PHIL 417, and LAWS 5135.

PHIL 420. The Phenomenological Tradition. 3 Units.
The background of phenomenology: Descartes, Kant, and Brentano. The epistemological rationale of Husserl's phenomenology and its ontological implications; the powers and limits of the phenomenological method. Heidegger's transformation of phenomenology to interpretive ontology of human existence. The development of interpretation theory as the foundation of all human existence. The development of interpretation theory as the foundation of all human sciences in Gadamer and Ricoeur. Recommended preparation: PHIL 101. Offered as PHIL 320 and PHIL 420.

PHIL 422. The Science of Happiness. 3 Units.
Open to all students (no prerequisites) interested in happiness, this course provides an intellectually rigorous introduction to the philosophy and science of happiness. Philosophy is often considered a dry academic subject; however the best philosophy is personal and transforms our view of the world. In recent years, science has made huge strides in understanding the psychology and neuroscience of human happiness. This course blends these two sources of insight to address such critical questions as: What is happiness? To what extent is it determined by our genes? To what extent can we control our own happiness? What factors contribute to an individual's happiness? Should we be concerned just with our own happiness, or also with the happiness of others? If happiness is a state of mind, can we change our thinking to make ourselves happier? Every self-proclaimed sage, and countless authors of self-help books, claims to know the secret to happiness. This course provides a more intellectually rigorous approach, based on the writings of great philosophers and cutting edge science. Offered as PHIL 322 and PHIL 422.

PHIL 425. Philosophy of Feminism. 3 Units.
Dimensions of gender difference. Definition of feminism. Critical examination of feminist critiques of culture, including especially politics, ideology, epistemology, ethics, and psychology. Readings from traditional and contemporary sources. Offered as PHIL 325, PHIL 425 and WGST 325. Counts for CAS Global & Cultural Diversity Requirement.
PHIL 430. Topics in Ethics. 3 Units.
Examination of views in ethics of a major philosopher or philosophical school, a significant philosophical topic in ethics, or a topic that relates ethics to philosophy and another discipline. Recommended preparation: PHIL 101 or PHIL 205. Offered as PHIL 330 and PHIL 430.

PHIL 433. Philosophy of Religion. 3 Units.
Topics include: classical and contemporary arguments for God’s existence; divine foreknowledge and human freedom; the problem of evil and theodicy; nature and significance of religious experience; mysticism; varieties of religious metaphysics; knowledge, belief and faith; nature of religious discourse. Readings from traditional and contemporary sources. Recommended preparation for PHIL 433 and RLGN 433: PHIL 101 or RLGN 102. Offered as PHIL 333, RLGN 333, PHIL 433, and RLGN 433.

PHIL 434. Political and Social Philosophy. 3 Units.
Justification of social institutions, primarily political ones. Such distinctions as that between de facto and legitimate authority; analysis of criteria for evaluation, such as social justice and equality; inquiry into theories of justification of the state; theory of democratic government and its alternatives. Readings from classical and contemporary sources. Recommended preparation: PHIL 101. Offered as PHIL 334, POSC 354, PHIL 434, and POSC 454.

PHIL 435. Philosophy of Law. 3 Units.
This is an examination of the general nature of law, the broad concerns of jurisprudence, the study of comparative law, and many of the issues raised in the literature of legal philosophy. Students will examine the principles of legal positivism, mitigated natural law, and rights theory. Selected readings and cases will illustrate these theories, which will also be examined in the context of rule selection by new governments in developing or revolutionary societies. The course also looks at the general nature of legal systems: how politics, morality, and individual views of justice and rights affect particular court cases and the course and development of law generally. Topics will include abortion, obscenity and sin, civil disobedience, affirmative action, surrogatehood, and the death penalty. This is unlike any other of the legal theory or jurisprudence courses, and those who have sampled legal theory elsewhere in a different form are welcome and encouraged to enroll. Recommended preparation: PHIL 101. Offered as LAWS 5747, PHIL 335, and PHIL 435.

PHIL 445. Epistemology and Metaphysics. 3 Units.
Traditional problems of epistemology, such as definition of knowledge, justification of belief, nature of evidence and foundationalism, skepticism, the a priori, and the role of sense perception in knowledge. Metaphysical presuppositions and implications of epistemological views. Forms of realism and anti-realism. Recommended preparation: PHIL 101. Offered as PHIL 345 and PHIL 445.

PHIL 455. 19th and Early 20th Century Philosophy. 3 Units.
History of philosophy after Kant up to and including logical empiricism. Interpretation and comparison of important philosophers and philosophical schools of the period in terms of common methods, problems, themes, doctrines, and ideologies. Emphasis on Schopenhauer, Hegel, Kierkegaard, Marx, and Nietzsche. Recommended preparation: PHIL 101. Offered as PHIL 355 and PHIL 455.

PHIL 456. Comparative Philosophy. 3 Units.
Philosophy in the etymological sense of the term, love of wisdom, subsumes ontological, ethical and epistemological inquires addressing fundamental questions about reality, the place of humans in that reality, the values of things and human obligations, and the sources of knowledge. The major purpose of this course is to discover, understand, explicate and articulate the affinities and differences in the way the fundamental questions are addressed in different cultural contexts, thereby to appreciate the cross-cultural kinship among human minds as well as to be challenged by the differences that may engender conflicts. We will explore the possibility of building a trans-cultural meta-cultural meta-discourse in which thinkers from many traditions can participate on equal footing. We will come to face up to the question whether truly universal philosophy is possible, upon what conditions. Representative texts from the Western, Chinese and Buddhist traditions including selected works of Plato, Aristotle, Augustine, Descartes, Kant, Nietzsche, Heidegger, Lao Tzu, Confucius, Chuang Tzu, Dhammapada of the Buddha and D. Suzuki’s Zen Buddhism will be read. Offered as PHIL 356 and PHIL 456. Counts for CAS Global & Cultural Diversity Requirement.

PHIL 466. Brain, Mind and Consciousness: The Science and Philosophy of Mind. 3 Units.
The course introduces students to key topics in philosophy of mind from the perspective of our increasingly advanced scientific understanding of mind and brain (e.g. derived from neuroscience, psychology and cognitive science). Key philosophical topics covered include dualism, physicalism, idealism, consciousness and free will. Key scientific issues covered include methods and assumptions underlying research in psychology and neuroscience, introspection, essentialism, dehumanizing, and work on free will and consciousness. No pre-requisites other than curiosity are required, however students will benefit from having previously taken courses in philosophy, neuroscience, psychology and/or computer science. Students are expected to complete the assigned readings with care and attention, and to participate in discussion. The goal is for students to leave with an understanding of the rich ways in which different approaches can shed light on the human mind, including an appreciation of the limits of scientific inquiry into the mind. Offered as PHIL 366 and PHIL 466.

PHIL 467. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467.
PHIL 475. Issues in Aesthetics. 3 Units.
This course will seek to offer insight into the nature of artistic expression, the role of criticism in the arts, and the place of the arts in society. The term “arts” will be construed broadly to include painting, photography, theater, film, music, dance, poetry, etc. The following are examples of questions we will discuss. What does the term “beautiful” mean? Are there other measures of aesthetic value besides beauty? Do the arts, like the sciences, offer us knowledge of the world? What value do the arts have for society? Can aesthetic value conflict with moral value? Do artists have a responsibility to society? Should art ever be censored? What is the relationship between art and entertainment? Is the meaning and value of an artistic work a matter of individual opinion? What is the purpose of art critics? How are interpretations and evaluations of art influenced by race, gender, class, etc.? What is creativity in the arts? Does it differ from creativity in the sciences? How important is originality in art? Offered as PHIL 375 and PHIL 475.

PHIL 484. Ethics and Public Policy. 3 Units.
Evaluation of ethical arguments in contemporary public policymaking discourse. That is, approaches to evaluating not only the efficiency of policy (Will this policy achieve its end for the least cost?) but also the ethics of policy (Are a policy’s intended ends ethically justified or “good,” and are our means to achieve those ends moral or “just”?). Overview of political ideologies that supply U.S. political actors with their ethical or moral arguments when proposing and implementing public policy, followed by an application of these differing perspectives to selected policy areas such as welfare, euthanasia, school choice, drug laws, censorship, or others. Offered as PHIL 384, PHIL 484, POSC 384 and POSC 484.

PHIL 485. Philosophy of Language. 3 Units.
Nature of language; problems of meaning, reference, and truth. Offered as PHIL 385 and PHIL 485.

PHIL 499. Independent Study MA Level. 1 - 3 Units.
This course enables graduate students in departments or interdisciplinary programs with an MA to pursue intensive directed study with a faculty member in Philosophy. Students should consult with the Instructor and with their MA director or graduate program director before enrolling. Prereq: Graduate Standing.

PHIL 599. Neuroscience of Positive Change: Using Brain Imaging to Promote the Good Life. 1.5 Unit.
The brain is the primary organ responsible for learning, decision making, social interaction, happiness, and self-regulation. Hence, neuroscience has the potential to inform numerous applied disciplines. Over the last few decades, fields from Organizational Behavior to Social Work, and Ethics to Nursing, have increasingly been drawing upon findings from neuroscience to inform their discipline. Researchers working in these disciplines are also now starting to conduct their own neuroscientific studies. However, applied researchers face an education gap that hinders progress in the productive use of neuroscience to inform their discipline. This course will provide an introduction to neuroscience methods for applied researchers, with a focus on how neuroscience can inform interventions designed to produce positive change in individuals. Students will gain an overview of the basic methods of cognitive neuroscience, effective experimental design, and the challenges of interpretation. In addition, students will be introduced to current research on the neuroscience of motivation, social-emotional competencies and behavior change. This is a graduate seminar class. Students must do the reading ahead of class. The majority of class time will be devoted to discussion.

PHIL 699. Advanced Tutorial and Dissertation for Candidates in fields related to Philosophy. 1 - 3 Units.
This course enables students in departments offering the Ph.D. to pursue intensive directed study with a faculty member in Philosophy, on philosophical aspects of their dissertation topic. Students should consult with the instructor and with their dissertation director before enrolling.

Department of Physics

The Department of Physics offers programs leading to the following undergraduate degrees: Bachelor of Arts, Bachelor of Science in physics, Bachelor of Science in mathematics and physics, and Bachelor of Science in engineering with an engineering physics major. Associated with the Bachelor of Science in physics degree are optional concentrations in mathematical physics and in biophysics. The department also offers the graduate degrees Master of Science and Doctor of Philosophy, as well as a unique master's degree in entrepreneurship.

All of these programs involve the study of the basic laws of nature and the properties of energy and matter in their various forms. The curriculum reflects the varied interests of the faculty and will prepare students for a wide range of future activities. At the undergraduate level, open electives and engineering physics concentration area courses tailor the programs to the student’s interests and career plans. Employment opportunities at the bachelor’s level include research, development, and technical assistance (engineering, computer programming, management) in industrial, government, and university settings.

A similar flexibility exists in the first few years of graduate study. The research leading to the PhD degree normally centers on a specific area of physics. However, even at this stage, the broad background and training characteristic of a physics degree are emphasized.

Undergraduate Programs

Majors
Course requirements and typical schedules for the majors are summarized in the Plan of Study Grids (click the button above).

Bachelor of Arts in Physics
The BA physics major includes a large number of elective courses, making it easy for the student to pursue other interests or complete a second major while earning a degree in physics.

Teacher Licensure Option
The physics department offers a special option for undergraduate students who wish to pursue a physics major and a career in teaching. The Adolescent to Young Adult (AYA) Teacher Education Program in Physical Sciences prepares CWRU students to receive an Ohio Teaching License for grades 7-12. Students declare a second major in education, which involves 34 hours in education and practicum requirements, and complete a planned sequence of physics courses within the context of the BA Physics major. The program is designed to offer several unique features not found in other programs and to place students in mentored teaching situations throughout their teacher preparation career. This
small, rigorous program is designed to capitalize on the strengths of CWRU’s physics department, its Teacher Education Program, and the relationships the university has built with area schools. (For details on education course work, see the program description for Teacher Licensure (p. 522) elsewhere in this bulletin.)

Bachelor of Science in Physics

The BS degree has two alternatives to the standard program: a mathematical physics concentration and a biophysics concentration.

BSE Degree in Engineering Physics

The BSE degree in engineering physics supplies an excellent background for graduate studies in physics, but is also designed for students who value an engineering credential and who are considering a career in engineering, either through employment following the BSE or through engineering graduate studies. This degree is awarded by the Case School of Engineering and includes the Engineering Core Curriculum. The technical electives in this program are concentrated in any of sixteen specific engineering areas.

BS in Mathematics and Physics

The BS in mathematics and physics is a single degree for students interested in advanced mathematics and theoretical physics. This degree is distinct from the mathematical physics concentration in the BS in physics degree. The program is jointly administered by the Department of Physics and the Department of Mathematics, Applied Mathematics, and Statistics. Students may be advised by faculty members from either department.

All BS, BA, and BSE candidates have an opportunity to complete a year-long research project in which they work one-on-one with a faculty researcher, write a senior thesis, and present their work in public.

Minor

Course requirements for the minor in physics are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 121 or PHYS 115 or PHYS 123</td>
<td>General Physics I - Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 122 or PHYS 116 or PHYS 124</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

Two of the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 301</td>
<td>Advanced Laboratory Physics I</td>
</tr>
<tr>
<td>PHYS 310</td>
<td>Classical Mechanics</td>
</tr>
<tr>
<td>PHYS 313</td>
<td>Thermodynamics and Statistical Mechanics</td>
</tr>
<tr>
<td>PHYS 315</td>
<td>Introduction to Solid State Physics</td>
</tr>
<tr>
<td>PHYS 316</td>
<td>Introduction to Nuclear and Particle Physics</td>
</tr>
<tr>
<td>PHYS 320</td>
<td>Introduction to Biological Physics</td>
</tr>
<tr>
<td>PHYS 324</td>
<td>Electricity and Magnetism I</td>
</tr>
<tr>
<td>PHYS 326</td>
<td>Physical Optics</td>
</tr>
<tr>
<td>PHYS 327</td>
<td>Laser Physics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 331</td>
<td>Introduction to Quantum Mechanics I</td>
</tr>
<tr>
<td>PHYS 332</td>
<td>Introduction to Quantum Mechanics II</td>
</tr>
</tbody>
</table>

Total Units 17

Graduate Programs in Physics

Overview

The graduate student in physics has two primary responsibilities: to broaden and deepen his or her own understanding of physics, and to contribute in a significant way to the progress of physics as a research discipline. Neither of these efforts can be completely separated from the other. Your understanding of physics is necessarily reflected in your research: your research will help to deepen your understanding of physics. However, the relative emphasis gradually shifts during graduate study from early concentration on formal course work to the original research necessary for a PhD dissertation.

At Case Western Reserve University, the formal requirements for the PhD degree are a course requirement, a qualifying examination, and a dissertation requirement. Exceptions to these departmental requirements are possible, and individual requests for changes will be carefully considered. There is no foreign language requirement.

Although most students apply to the department’s PhD program, the department maintains a master’s degree program as well. This program involves fewer courses than the PhD program, and may or may not involve a dissertation, depending upon the student’s needs and interests. The requirements for the master’s degree are outlined in the relevant section below.

The department also has a master’s track in Physics Entrepreneurship. This program is designed for students who have a background in physics and a passion for innovation, entrepreneurship, and working for small companies and startups. Students study graduate-level physics, practical business, and technology innovation while working on a real-world entrepreneurial project with an existing company or their own startup. The Physics Entrepreneurship Program helps connect students with mentors, advisors, partners, funding sources and job opportunities. The requirements for this master’s track are outlined in the relevant section below.

The department also has a master’s track in Physics Entrepreneurship. This program is designed for students who have a background in physics and a passion for innovation, entrepreneurship, and working for small companies and startups. Students study graduate-level physics, practical business, and technology innovation while working on a real-world entrepreneurial project with an existing company or their own startup. The Physics Entrepreneurship Program helps connect students with mentors, advisors, partners, funding sources and job opportunities. The requirements for this master’s track are outlined in the relevant section below.

Requirements for Graduation

Requirements for the Ph.D. degree include course work, the PhD qualifying examination, a topical oral examination, and submission and defense of a written thesis.

Requirements for the master’s degree include course work and either a comprehensive examination or a thesis.

Required Courses for the PhD Degree

With the help of a faculty advisor, students choose a curriculum of course work from among a large array of offerings in physics and related science and engineering departments. The university requires a total of 36 hours
of course work for students entering with a bachelor's degree, or 18 hours of course work for those students entering with a master's degree. This requirement may be met by supervised research, by lecture courses, by reading courses, or a combination. Twelve of the course hours involve required courses, but any of these requirements may be waived for students who have had the equivalent material elsewhere or, in the case of Graduate Laboratory, equivalent experience elsewhere. The required courses are:

**Two from the following five:**
- PHYS 427 Laser Physics
- PHYS 431 Physics of Imaging
- PHYS 441 Physics of Condensed Matter I
- PHYS 451 Empirical Foundations of the Standard Model
- PHYS 465 General Relativity or PHYS 436 Modern Cosmology

Additionally, students are required to take PHYS 472 Graduate Physics Laboratory plus one additional 400- or 500-level lecture course from the following list:
- PHYS 442 Physics of Condensed Matter II
- PHYS 451 Empirical Foundations of the Standard Model
- PHYS 460 Advanced Topics in NMR Imaging
- PHYS 539 Special Topics Seminar
- PHYS 566 Cosmology
- PHYS 581 Quantum Mechanics III
- PHYS 591 Gauge Field Theory I

*Other courses, either in physics or in other departments, may be substituted by petition. Note that courses that have dual listings with 300-level courses generally do not satisfy this requirement.

Although not required, most students take the following introductory courses during the first year, as much of the PhD qualifying exam is based on material in these courses:
- PHYS 331 Introduction to Quantum Mechanics I and PHYS 332 Introduction to Quantum Mechanics II
- PHYS 423 Classical Electromagnetism
- PHYS 413 Classical and Statistical Mechanics I and PHYS 414 Classical and Statistical Mechanics II

The classroom lecture courses will be augmented by official reading courses, which will have specified syllabi (published in the catalogue and monitored by the Graduate Committee), graded homework, and final examinations. Courses in special topics, as well as individualized study, can be arranged by mutual consent when the demand is sufficient.

**Required Courses for the Master's Degree**

The requirements for the MS degree depend on whether or not the candidate completes the research and writing for a master's thesis. A total of 27 credit hours of graduate course work must be completed. The two options corresponding to Program A (with thesis) and Program B (without thesis) are as follows:

**Program A: MS with Thesis**
- PHYS 413 Classical and Statistical Mechanics I (3 hours)
- PHYS 423 Classical Electromagnetism (3 hours)
- PHYS 651 Thesis M.S. (6 to 9 hours)

**Program B: MS without Thesis**
- Other graduate courses (15 to 12 hours, of which at least 6 must be in physics)
- Thesis and oral defense

The 27 hours of required courses can generally be completed in three semesters, though thesis research and writing may take longer. Candidates must be in residence (paying tuition) during the semester in which they complete requirements and receive the degree; applications for degree should be filed early in the third semester. Candidates for the PhD degree may apply for and receive the MS degree on the basis of work completed toward the PhD.

**Required Courses for the Master's Degree, Entrepreneurship Track**

The requirements for the master's degree, Entrepreneurship Track, are 27 credit hours as follows:
- PHYS 491 Modern Physics for Innovation I (3 hours)
- PHYS 492 Modern Physics for Innovation II (3 hours)
- PHYS 493 Feasibility and Technology Analysis (3 hours)
- PHYS 494 Technology-Based Venture Creation (3 hours)
- 400-level Physics Elective (3 hours)
- Restricted Elective (3 - 6 hours)
- Thesis work (PHYS 651) (6 - 9 hours)

The program is typically a two-year program.

**Additional Courses for Cultural Purposes**

The university permits graduate students to enroll in up to eight "fellowship" courses that are not counted toward the degree requirements for no additional charge. These may include courses in foreign language, history, philosophy, business and management, music, engineering, etc. These courses will be graded, and a grade will appear on the student's transcript.

**PhD Qualifying Examination and Master's Comprehensive Examination**

The PhD qualifying examination is based on advanced undergraduate material and on material covered in the introductory courses: Quantum Mechanics I & II; Classical Electromagnetism; and Classical and Statistical Mechanics I & II. Additionally, written material from the graduate laboratory course and undergraduate courses (such as relativity) may be incorporated into the qualifying exam.

A normally prepared student will be expected to take the qualifying examination in May at the end of the first year of graduate study. Students who fail the first time will speak with the chair of the qualifying committee and Director of Graduate Studies to ascertain if there is a disconnect between knowledge and performance on the exam. They will discuss with the student how best to maximize the chance of passing on the student's second attempt, generally in mid to late August. For students not passing the second time, the chair of the qualifying
committee and Director of Graduate Studies will discuss the student's future plans, or the unusual possibility of a third exam.

Program B candidates for the master's degree (not Entrepreneurship Track) must complete a comprehensive examination. This examination is identical to, and offered at the same time as, the PhD qualifying examination. The passing grade for the master's exam is set lower than the passing grade for the PhD qualifying examination. Students who fail the first time will be allowed a second opportunity in August. Under special circumstances, students may be given an oral examination instead of a written exam.

The PhD qualifying and master's comprehensive examination consists of a written two-day examination. Several months in advance of the date for the qualifying examination, a written announcement is made which gives more specific details about the forthcoming examination. Previous examinations are on file and available to students.

Admission to PhD Candidacy

A student will be admitted to PhD candidacy upon passing the qualifying exam and upon a vote of the faculty to determine whether the student is making satisfactory academic progress.

Topical Oral Exam

Within one year of formal association with a research advisor, but no later than the end of the fifth semester after a student matriculates, each student will have an oral examination of her/his research progress with the dissertation committee. The examination will consist of a presentation by the student relating to literature in her/his thesis topic, a proposed direction for work, and a progress report. Passing this examination is a requirement for the PhD degree. If the time deadline cannot be met because of extenuating circumstances, the student may petition the graduate committee for an extension.

Advising

Upon entry to graduate school, the master’s or PhD student’s academic advisor will be the department’s Director of Graduate Studies. Eventually, each successful student will acquire a research advisor and dissertation committee. At that time, the responsibility of the Director of Graduate Studies will greatly diminish, but not vanish entirely. It will remain the Director’s responsibility to assist the research advisor in academic matters. The Director of Graduate Studies, as well as the research advisor, will countersign the student’s course program. It is the responsibility of the Director of Graduate Studies to follow the career of the student and see that all requirements for the degree are fulfilled.

The director of the Physics Entrepreneurship Program will be the academic advisor for students in the Entrepreneurship Track of the master’s program. Each successful student will also acquire a research advisor and thesis committee, which will meet with the student at least once per semester. It is the responsibility of the director of the Physics Entrepreneurship Program to follow the career of the students in this track and see that all requirements for the degree are fulfilled.

PhD Research and Dissertation

A PhD degree implies, in addition to the course and qualifying exam requirements, the performance of a piece of original research and its presentation as a doctoral dissertation. The research requirement for the PhD is at the heart of the doctoral program. The final requirement for the PhD degree is the written doctoral dissertation and oral defense.

Entering students should interest themselves in the available research possibilities in the physics department at an early state of their careers. They should be thinking about the area of interest, the kind of problem they would like to tackle, and the faculty member under whose direction they would like to work. As soon as they have passed the qualifying exam, they should devote themselves increasingly to research.

By January or February of the first year, the student should begin to speak with faculty members about their research, and ultimately find a faculty member who will sponsor and supervise the student’s work. The relationship between a student and research advisor is a very close one. It is in the course of this relationship that students develop their skills in the actual doing of physics. Students should give much thought to their choice of research area and research advisor. Once a student has made this commitment, it takes the highest priority. Students must understand that they are unlikely to bring their thesis research to a successful conclusion without a total commitment on their part. Our policy on financial support of graduate students reflects the importance of such a commitment. Renewal of a student’s support will be contingent upon evidence of progress toward a degree.

Colloquia and Seminars

In addition to course work and individualized direction in research, the physics department provides a third medium of teaching, colloquia and seminars, which are shared by students and faculty alike.

Colloquia are talks of a general nature, given at a level that all graduate students in all areas of physics should be able to follow. They are usually held on Thursdays. Notices (and, whenever possible, brief introductions to the subject) will be distributed well in advance of each colloquium. Graduate students are urged and expected to attend all of these colloquia. (All graduate students are required to register each semester for the zero-credit-hour course PHYS 666 Frontiers in Physics, which consists of attendance at colloquia.)

Seminars tend to deal with more specific topics and often require some expertise in the field. Some groups hold weekly luncheon seminars; others meet whenever a speaker is available. Advanced students are expected not only to attend, but also to participate in the seminars in their fields. Students who have not yet chosen a field of research may find the seminars a valuable means of sampling the types of research available. Students in the Entrepreneurship Track are expected to attend all of that program’s seminars, and are encouraged to attend other relevant seminars.

Policy on Working Outside the Department

The teaching and research assistantships represent a rich and exciting experience and a total time commitment on the part of both the graduate student and his or her advisor. It is generally not advisable for a student to accept other employment or non-family responsibilities, inside or outside of the department or university. If a student nevertheless desires an additional position, written approval must first be obtained from the student’s advisor, and a petition then made to the Graduate Committee. Prior approval of the committee is required in order to avoid a possible reduction or termination in assistantship financial support.

A variety of special circumstances may arise in the case of students in the Entrepreneurship Track. Oversight will be provided by the Physics Entrepreneurship Committee, and approval of the director of the Physics Entrepreneurship Program is required.
### Requirements Tables for Physics Programs

#### Bachelor of Arts in Physics

The Bachelor of Arts degree with a physics major requires completion of the Arts and Sciences General Education Requirements (GER) and 120 total credits, of which 50 are specified by the physics department as shown below. Courses specified for this major satisfy the 6-credit Arts and Sciences GER in Sciences and Mathematics.

<table>
<thead>
<tr>
<th>One of the following:</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 115</td>
<td>Introductory Physics I</td>
</tr>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
</tr>
<tr>
<td>PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>One of the following:</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 116</td>
<td>Introductory Physics II</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
</tr>
<tr>
<td>PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All of the following:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
</tr>
<tr>
<td>PHYS 301</td>
<td>Advanced Laboratory Physics I</td>
</tr>
<tr>
<td>PHYS 303</td>
<td>Advanced Laboratory Physics Seminar</td>
</tr>
<tr>
<td>PHYS 313</td>
<td>Thermodynamics and Statistical Mechanics</td>
</tr>
<tr>
<td>PHYS 331</td>
<td>Introduction to Quantum Mechanics I</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Two of the following:</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
</tr>
<tr>
<td>PHYS 310</td>
<td>Classical Mechanics</td>
</tr>
<tr>
<td>PHYS 315</td>
<td>Introduction to Solid State Physics</td>
</tr>
<tr>
<td>PHYS 316</td>
<td>Introduction to Nuclear and Particle Physics</td>
</tr>
<tr>
<td>PHYS 320</td>
<td>Introduction to Biological Physics</td>
</tr>
<tr>
<td>PHYS 324</td>
<td>Electricity and Magnetism I</td>
</tr>
<tr>
<td>PHYS 326</td>
<td>Physical Optics</td>
</tr>
<tr>
<td>PHYS 327</td>
<td>Laser Physics</td>
</tr>
<tr>
<td>PHYS 328</td>
<td>Cosmology and the Structure of the Universe</td>
</tr>
<tr>
<td>PHYS 336</td>
<td>Modern Cosmology</td>
</tr>
<tr>
<td>PHYS 365</td>
<td>General Relativity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All of the following:</th>
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</thead>
<tbody>
<tr>
<td>Intro Science 1</td>
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</tr>
<tr>
<td>Intro Science 2</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 131 or EECS 132</td>
<td>Elementary Computer Programming</td>
</tr>
<tr>
<td>or EECS 132</td>
<td>Introduction to Programming in Java</td>
</tr>
<tr>
<td>MATH 121 or MATH 125</td>
<td>Calculus for Science and Engineering I</td>
</tr>
<tr>
<td>or MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>One of the following:</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
</tr>
</tbody>
</table>

#### Typical Schedule

##### First Year

<table>
<thead>
<tr>
<th></th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Physics I - Mechanics (PHYS 121) or Physics and Frontiers I - Mechanics (PHYS 123)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Intro Science Elective I</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>SAGES First Seminar</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Physics Today and Tomorrow (PHYS 166)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PHED Physical Education Activities</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering II (MATH 122)</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Students may choose only one of these two courses to satisfy the requirements of the BA degree.

A two-course science sequence chosen from ASTR 221 Stars and Planets and ASTR 222 Galaxies and Cosmology; CHEM 105 Principles of Chemistry I and CHEM 106 Principles of Chemistry II; CHEM 111 Principles of Chemistry for Engineers and ENGR 145 Chemistry of Materials; BIOL 214 Genes, Evolution and Ecology and BIOL 215 Cells and Proteins; EEPS 101 (Earth & Planets) or EEPS 110 (Physical Geology); and EEPS 115 (Introduction to Oceanography) or EEPS 117 (Weather and Climate or another two-course sequence totaling 6 or more credits in a quantitative science (other than physics), with approval of the physics undergraduate curriculum committee.

PHYS 303 + PHYS 352 can be used to satisfy this requirement.

PHYS 351 can be used to satisfy this requirement.

The breadth requirements include 6 hours of Social Sciences and 6 hours of Arts and Humanities. This may increase by 3 credits if the required Global and Cultural Diversity course is not also one of the breadth requirement courses. Courses required for the BA in Physics satisfy the 6-credit GER for Natural Sciences and Mathematics as well as the Quantitative Reasoning course requirement.

The number of open electives will vary depending on course choices made by each student. The BA degree requires a minimum of 30 semester hours at the 300-400 level, of which only 16 are specified as PHYS courses. No more than 42 hours beyond the 100-level in any one department (the physics BA specifies 19 such credits) may be applied to the 120 credit total and at least 90 credits must be in the College of Arts and Sciences.
### Bachelor of Science in Physics

The Bachelor of Science in physics requires completion of the courses listed in the table below as well as the Arts and Sciences General Education Requirements, for a total of 127 credits. Many courses may be taken at times other than those shown in the "Typical Schedule" tables below.

<table>
<thead>
<tr>
<th>Second Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Modern Physics (PHYS 221)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculus for Science and Engineering III (MATH 223)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University Seminar</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humanities/Social Science Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Physics Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary Differential Equations (MATH 224)</td>
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<td>Humanities/Social Science Elective</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
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<td></td>
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<tr>
<td>Open Elective</td>
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<tr>
<td>Year Total:</td>
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<td>15</td>
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</table>

<table>
<thead>
<tr>
<th>Third Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Laboratory Physics I (PHYS 301)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Laboratory Physics Seminar (PHYS 303)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermodynamics and Statistical Mechanics (PHYS 313)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Quantum Mechanics I (PHYS 331)</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Humanities/Social Science Elective</td>
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<td></td>
<td></td>
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<tr>
<td>Open Elective</td>
<td>2</td>
<td></td>
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<tr>
<td>Physics Elective</td>
<td>3</td>
<td></td>
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<tr>
<td>Global and Cultural Diversity Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humanities/Social Science Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
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<td>15</td>
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</table>

<table>
<thead>
<tr>
<th>Fourth Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Physics Project (PHYS 351)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Physics Project Seminar (PHYS 352)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Physics Project (PHYS 351)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Physics Project Seminar (PHYS 352)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Year Total: | 15 | 12 |

| Total Units in Sequence: | 120 | | |
MATH 122  Calculus for Science and Engineering II  4
or MATH 124  Calculus II  4
MATH 223  Calculus for Science and Engineering III  3
or MATH 227  Calculus III  3
MATH 224  Elementary Differential Equations  3
SAGES First and University Seminars  10
SAGES Departmental Seminar  2
SAGES Capstone  3-4
Breadth Requirements  12
Open Electives  23-19
PHED Physical Education (2 semesters)  0
Total Units  127

1  PHYS 303 Advanced Laboratory Physics Seminar + PHYS 352 Senior Physics Project Seminar can be used to satisfy this requirement.

2  PHYS 351 can be used to satisfy this requirement.

3  The breadth requirements include 6 hours of Social Sciences and 6 hours of Arts and Humanities. This may increase by 3 credits if the required Global and Cultural Diversity course is not also one of the breadth requirement courses. Courses required for the BS in physics satisfy the 6-credit GER for Natural Sciences and Mathematics as well as the Quantitative Reasoning course requirement.

4  The number of open electives may vary, depending on course choices made by the student, but the degree requires that the total number of credits be at least 127.

Typical Schedule

First Year

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>Fall</td>
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<tr>
<td>Spring</td>
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General Physics I - Mechanics (PHYS 121)  4
or Physics and Frontiers I - Mechanics (PHYS 123)  4
Calculus for Science and Engineering I (MATH 121)  4
Principles of Chemistry I (CHEM 105)  3-4
or Principles of Chemistry for Engineers (CHEM 111)  3-4
SAGES First Seminar  4
Physics Today and Tomorrow (PHYS 166)  1
PHED Physical Education Activities  0
General Physics II - Electricity and Magnetism (PHYS 122)  4
or Physics and Frontiers II - Electricity and Magnetism (PHYS 124)  4
Calculus for Science and Engineering II (MATH 122)  4
Principles of Chemistry II (CHEM 106)  3-4
or Chemistry of Materials (ENGR 145)  3-4
Elementary Computer Programming (ENGR 131)  3
University Seminar  3
PHED Physical Education Activities  0
Year Total:  16-17  17-18

Second Year

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Analog and Digital Electronics (PHYS 203)  4
Introduction to Modern Physics (PHYS 221)  3
Calculus for Science and Engineering III (MATH 223)  3
University Seminar  3
Humanities/Social Science Elective  3
Advanced Instrumentation Laboratory (PHYS 204)  4
Computational Methods in Physics (PHYS 250)  3
Classical Mechanics (PHYS 310)  3
Elementary Differential Equations (MATH 224)  3
Humanities/Social Science Elective  3
Year Total:  16  16

Third Year

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Advanced Laboratory Physics I (PHYS 301)  3
Advanced Laboratory Physics Seminar (PHYS 303)  1
Thermodynamics and Statistical Mechanics (PHYS 313)  3
Introduction to Quantum Mechanics I (PHYS 331)  3
Humanities/Social Science Elective  3
Open Elective  3
Advanced Laboratory Physics II (PHYS 302)  4
Electricity and Magnetism I (PHYS 324)  3
Introduction to Quantum Mechanics II (PHYS 332)  3
Global and Cultural Diversity Elective  3
Open Elective  3
Year Total:  16  16

Fourth Year

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<td>Spring</td>
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Electricity and Magnetism II (PHYS 325)  3
Senior Physics Project (PHYS 351)  2
Senior Physics Project Seminar (PHYS 352)  1
Condensed Matter Physics Elective  3
Open Elective  3
Open Elective  3
Senior Physics Project (PHYS 351)  2
Senior Physics Project Seminar (PHYS 352)  1
Particle/Astrophysics Elective  3
Humanities/Social Science Elective  3
Open Elective  3
Open Elective  3-1
Year Total:  15  15-13

Total Units in Sequence:  127

Bachelor of Science in Physics with Mathematical Physics Concentration

Students who are interested in theoretical physics and who have a strong background in mathematics may consider this concentration. The program is based on the BS in physics, but with certain substitutions in
the course requirements. Several of the laboratory courses are replaced by advanced mathematics courses, and some of the undergraduate physics courses are replaced by graduate courses.

This program is not the same as the BS program in mathematics and physics, which provides a coherent and parallel education in both mathematics and physics.

The following table shows the requirements for the Bachelor of Science in physics with mathematical physics concentration.

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<thead>
<tr>
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<th>Course Title</th>
<th>Units</th>
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<tr>
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<td>Physics and Frontiers I - Mechanics</td>
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<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
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<td>PHYS 203</td>
<td>Analog and Digital Electronics</td>
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<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
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<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
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<td>PHYS 301</td>
<td>Advanced Laboratory Physics I</td>
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<td>PHYS 303</td>
<td>Advanced Laboratory Physics Seminar</td>
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<td>PHYS 310</td>
<td>Classical Mechanics</td>
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<td>PHYS 313</td>
<td>Thermodynamics and Statistical Mechanics</td>
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<td>PHYS 349</td>
<td>Methods of Mathematical Physics I</td>
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<td>PHYS 350</td>
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<tr>
<td>PHYS 481</td>
<td>Quantum Mechanics I</td>
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<tr>
<td>Choose PHYS 423 or both PHYS 324 &amp; PHYS 325</td>
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<td>PHYS 423</td>
<td>Classical Electromagnetism</td>
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<td>PHYS 324</td>
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<td>PHYS 482</td>
<td>Quantum Mechanics II</td>
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<tr>
<td>M-Group 1, 2 &amp; 3</td>
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<tr>
<td>Choose one of the following:</td>
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<tr>
<td>PHYS 315</td>
<td>Introduction to Solid State Physics</td>
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<td>PHYS 320</td>
<td>Introduction to Biological Physics</td>
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<td>PHYS 326</td>
<td>Physical Optics</td>
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<td>PHYS 327</td>
<td>Laser Physics</td>
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<td>Choose one of the following:</td>
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<tr>
<td>PHYS 316</td>
<td>Introduction to Nuclear and Particle Physics</td>
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<td>Modern Cosmology</td>
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<td>PHYS 365</td>
<td>General Relativity</td>
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<td>Principles of Chemistry I</td>
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<td>Principles of Chemistry for Engineers</td>
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<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
<td>3-4</td>
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<tr>
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<td>Chemistry of Materials</td>
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<tr>
<td>ENGR 131</td>
<td>Elementary Computer Programming</td>
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<tr>
<td>or EECS 132</td>
<td>Introduction to Programming in Java</td>
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<tr>
<td>MATH 121</td>
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<td>MATH 122</td>
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<td>or MATH 124</td>
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<td>MATH 223</td>
<td>Calculus for Science and Engineering III</td>
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<tr>
<td>or MATH 227</td>
<td>Calculus III</td>
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</tr>
<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
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<tr>
<td>SAGES First and University Seminars</td>
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<tr>
<td>SAGES Departmental Seminar</td>
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<td>2-3</td>
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<tr>
<td>SAGES Capstone</td>
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<td>3-4</td>
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<tr>
<td>Open Electives</td>
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<td>19-15</td>
</tr>
<tr>
<td>PHED 2 semesters</td>
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</tbody>
</table>

Total Units: 127

1. M-group 1, 2 and 3 are to be chosen, in consultation with the advisor, from among approved advanced mathematics or statistics courses.
2. PHYS 303 Advanced Laboratory Physics Seminar + PHYS 352 Senior Physics Project Seminar can be used to satisfy the SAGES departmental seminar requirement.
3. PHYS 351 can be used to satisfy the SAGES capstone requirement.
4. The breadth requirements include 6 hours of Social Sciences and 6 hours of Arts and Humanities. This may increase by 3 credits if the required Global and Cultural Diversity course is not also one of the breadth requirement courses. Courses required for the BS in physics satisfy the 6-credit GER for Natural Sciences and Mathematics as well as the Quantitative Reasoning course requirement.
5. The number of open electives may vary, depending on course choices made by the student, but the degree requires that the total number of credits be at least 127.

**Typical Schedule**

**First Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
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<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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<tr>
<td>or MATH 124</td>
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<td>MATH 223</td>
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<td>or MATH 227</td>
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<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
<td>3</td>
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<td>SAGES First and University Seminars</td>
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<td>2-3</td>
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<tr>
<td>SAGES Capstone</td>
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<td>Breadth Requirements</td>
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<tr>
<td>Open Electives</td>
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<td>19-15</td>
</tr>
<tr>
<td>PHED 2 semesters</td>
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</table>

Year Total: 16-17 17-18
## Bachelor of Science in Physics with Biophysics Concentration

This concentration is directed towards students interested in the combined study of biology and physics. The degree is a track within the standard BS in physics, in which four physics courses and certain open electives are replaced by a "biogroup" of five courses and a technical elective.

The following table illustrates the requirements for the Bachelor of Science in physics with biophysics concentration.

<table>
<thead>
<tr>
<th>Course (PHYS)</th>
<th>Title</th>
<th>Units</th>
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<tr>
<td>PHYS 121</td>
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<td>or PHYS 123</td>
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<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<tr>
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<td>PHYS 331</td>
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Total Units in Sequence: 127

## Second Year

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<th>Course (PHYS)</th>
<th>Title</th>
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<tbody>
<tr>
<td>PHYS 203</td>
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<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
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<td>PHYS 223</td>
<td>Calculus for Science and Engineering III</td>
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<td>Computational Methods in Physics (PHYS 250)</td>
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<td>CLASSICAL MECHANICS (PHYS 310)</td>
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<td>Elementary Differential Equations (MATH 224)</td>
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## Third Year

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<td>Methods of Mathematical Physics I (PHYS 349)</td>
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<td>Quantum Mechanics I (PHYS 481)</td>
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## Fourth Year

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<td>Condensed Matter Physics Elective</td>
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<tr>
<td>Advanced Mathematics Elective</td>
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<td>Electricity and Magnetism II (PHYS 325)</td>
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<td>Particle/Astrophysics Elective</td>
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Total Units in Sequence: 127
Suggested technical electives include PHYS 315 Introduction to Solid State Physics, PHYS 316 Introduction to Nuclear and Particle Physics, PHYS 320 Introduction to Biological Physics, PHYS 326 Physical Optics, PHYS 327 Laser Physics, PHYS 328 Cosmology and the Structure of the Universe, PHYS 336 Modern Cosmology, PHYS 365 General Relativity.

B-group 1-5 are to be chosen in consultation with the biophysics academic advisor from among approved biology, biophysics, biochemistry, and biomedical engineering courses, including certain prerequisites as needed (e.g., chemistry). BIOL 214 Genes, Evolution and Ecology and BIOL 215 Cells and Proteins are suggested for B-group 1 and 2. PHYS 320 may be used as a B-group option if it is not selected as a PHYS technical elective. The listing of credits includes numbers for the most likely choices of courses and, in parentheses, possible alternatives.

PHYS 303 Advanced Laboratory Physics Seminar + PHYS 352 Senior Physics Project Seminar can be used to satisfy the SAGES departmental seminar requirement.

The breadth requirements include 6 hours of Social Sciences and 6 hours of Arts and Humanities. This may increase by 3 credits if the required Global and Cultural Diversity course is not also one of the breadth requirement courses. Courses required for the B.S. in physics satisfy the 6-credit GER for Natural Sciences and Mathematics as well as the Quantitative Reasoning course requirement.

The number of open electives may vary, depending on course choices made by the student, but the degree requires that the total number of credits be at least 127.

**Typical Schedule**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Fall</th>
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Total Units in Sequence: 127

**Bachelor of Science in Engineering with Engineering Physics Major**

The engineering physics major allows students with strong interests in both physics and engineering to concentrate their studies in the common areas of these disciplines. The major prepares students to
pursue careers in industry, either directly after undergraduate studies, or following graduate study in engineering or physics. Many employers value the unique problem-solving approach of physics, especially in industrial research and development. Its engineering science and design components prepare students to work as professional engineers.

Students majoring in engineering physics complete the Engineering Core as well as a rigorous course of study in physics. Students select a concentration area from an engineering discipline, and must complete a sequence of at least four courses in this discipline. In addition, a senior research project under the guidance of a faculty member is required. The project includes a written report and participation in the senior seminar and symposium. The major requires the engineering general education requirements (p. 1072) and university general education requirements (p. 1053).

### First Year

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**Total Units in Sequence:** 129

1. Selected students may be invited to take MATH 123, 124, 227, and 228 in place of MATH 121, 122, 223, and 224.
2. Selected students may be invited to take PHYS 123, 124 (Physics and Frontiers I, II Honors) in place of PHYS 121, 122.
3. Engineering physics concentration courses are flexible, but they must be in a specific engineering discipline or study area and approved by an advisor. Possible concentration areas include aerospace engineering, biomedical engineering “hardware,” biomedical engineering “software,” chemical engineering, civil engineering (solid mechanics, structural and geotechnical, environmental), computer science, computer systems hardware, computer systems software, control systems and automation, electrical engineering, macromolecular science, materials science and engineering, mechanical engineering, signal processing, systems analysis and decision making.
4. EECS 321, PHYS 315, PHYS 327, PHYS 332. Students may choose to fulfill this requirement in their third year.

### Bachelor of Science in Mathematics and Physics

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**Typical Schedule**

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The “MP group” of four courses corresponds to two physics courses and two mathematics courses. The physics courses are chosen from PHYS 250 Computational Methods in Physics, PHYS 349 Methods of Mathematical Physics I, and PHYS 350 Methods of Mathematical Physics II. The mathematics courses are subject to approval by the MP committee and are hence referred to as “approved electives.” They may be chosen from the general list of mathematics courses at the 300 level or higher. It may also be possible to choose a course outside the mathematics and physics departments as a substitute in the MP group, subject to approval by the committee.

Other science sequence courses may be substituted if approved by the mathematics and physics (MP) committee.

Or other approved computational course

An advanced physics course to be selected from the following list: PHYS 315 Introduction to Solid State Physics, PHYS 316 Introduction to Nuclear and Particle Physics, PHYS 320 Introduction to Biological Physics, PHYS 326 Physical Optics, PHYS 327 Laser Physics, PHYS 328 Cosmology and the Structure of the Universe, PHYS 336 Modern Cosmology, PHYS 365 General Relativity.

Students are encouraged to take either the Math or Physics SAGES departmental seminar and capstone courses but should then take both courses from the same department. The physics departmental seminar consists of 1 credit of PHYS 303 Advanced Laboratory Physics Seminar +PHYS 352 Senior Physics Project Seminar.

The breadth requirements include 6 hours of Social Sciences and 6 hours of Arts and Humanities. This may increase by 3 credits if the required Global and Cultural Diversity course is not also one of the breadth requirement courses. Courses required for the BS in mathematics and physics satisfy the 6-credit GER for Natural Sciences and Mathematics as well as the Quantitative Reasoning course requirement.

The number of open electives may vary as determined by the degree requirement that the total number of credits be at least 126.
### PHED Physical Education Activities

<table>
<thead>
<tr>
<th>Year Total:</th>
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<th>17-18</th>
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### Second Year

<table>
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<tr>
<th>Units</th>
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<tbody>
<tr>
<td><strong>Introduction to Modern Physics (PHYS 221)</strong></td>
<td>3</td>
<td></td>
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<tr>
<td><strong>Calculus for Science and Engineering III (MATH 223) or Calculus III (MATH 227)</strong></td>
<td>3</td>
<td></td>
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<tr>
<td><strong>Linear Algebra (MATH 307)</strong></td>
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<td><strong>University Seminar</strong></td>
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<tr>
<td><strong>Humanities/Social Science Elective</strong></td>
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<tr>
<td><strong>Open Elective</strong></td>
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<tr>
<td><strong>Classical Mechanics (PHYS 310)</strong></td>
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<td><strong>Elementary Differential Equations (MATH 224)</strong></td>
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<tr>
<td><strong>Introduction to Abstract Algebra (MATH 308)</strong></td>
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<td><strong>MATH/PHYS Elective</strong></td>
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<td><strong>Humanities/Social Science Elective</strong></td>
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### Third Year

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<th>Units</th>
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<tr>
<td><strong>Thermodynamics and Statistical Mechanics (PHYS 313)</strong></td>
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<tr>
<td><strong>Introduction to Quantum Mechanics I (PHYS 331) or Quantum Mechanics I (PHYS 481)</strong></td>
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<td><strong>Fundamentals of Analysis I (MATH 321)</strong></td>
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<tr>
<td><strong>SAGES Departmental Seminar</strong></td>
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<tr>
<td><strong>Introduction to Quantum Mechanics II (PHYS 332) or Quantum Mechanics II (PHYS 482)</strong></td>
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<tr>
<td><strong>Fundamentals of Analysis II (MATH 322)</strong></td>
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<td><strong>Introduction to Complex Analysis (MATH 324)</strong></td>
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<td><strong>Global and Cultural Diversity Elective</strong></td>
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### Fourth Year

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<td><strong>SAGES Capstone</strong></td>
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<td><strong>Physics Elective</strong></td>
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<td><strong>Classical Electromagnetism (PHYS 423)</strong></td>
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<tr>
<td><strong>Graduate Physics Laboratory (PHYS 472)</strong></td>
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</table>

### Total Units in Sequence: 126

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### Department Faculty

**Kathleen Kash, PhD**  
*(Massachusetts Institute of Technology)*  
**Professor and Chair**  
Experimental condensed matter and mesoscopic physics; synthesis and characterization of novel nitride semiconductors

**Jesse Berezovsky, PhD**  
*(University of California, Santa Barbara)*  
**Associate Professor**  
Imaging coherent transport in mesoscopic graphene; optical readout of single spin dynamics in a quantum dot; spin dynamics in layered core/shell nanocrystal quantum dots; measurements of nuclear and electron spin at a ferromagnetic/semiconductor interface; spatio-temporal imaging and simulation of magnetization dynamics in ferromagnetic structures

**Robert W. Brown, PhD**  
*(Massachusetts Institute of Technology)*  
**Distinguished University Professor and Institute Professor**  
Medical imaging; industrial physics; particle physics theory; cosmology

**Edward M. Caner, MS**  
*(Case Western Reserve University)*  
**Instructor**  
Science entrepreneurship

**Gary S. Chottiner, PhD**  
*(University of Maryland)*  
**Professor, Director of Undergraduate Studies**  
Experimental physics of surfaces and thin films

**Corbin E. Covault, PhD**  
*(Harvard University)*  
**Professor**  
Theoretical cosmology; particle physics; astrophysics

**Diana I. Driscoll, PhD**  
*(Case Western Reserve University)*  
**Instructor**  
Introductory physics

**Pavel Fileviez Perez, PhD**  
*(Max Planck Institute for Physics)*  
**Assistant Professor**  
Particle and astro-particle physics

**Xuan Gao, PhD**  
*(Columbia University)*  
**Associate Professor**  
Experimental condensed matter physics; nanomaterials; electron transport in nanostructures; correlated electrons in low dimensions

**Michael Hinczewski, PhD**  
*(Massachusetts Institute of Technology)*  
**Assistant Professor**  
Theoretical biophysics
Kurt Hinterbichler, PhD  
(Columbia University)  
**Warren E. Rupp Assistant Professor**  
Theoretical particle physics; astrophysics; cosmology

Peter J. Kernan, PhD  
(Ohio State University)  
**Instructor**  
Cosmology; astrophysics

Walter R. Lambrecht, PhD  
(University of Ghent)  
**Professor**  
Theoretical condensed matter physics; electronic structure-based physics of materials

Michael A. Martens, PhD  
(Case Western Reserve University)  
**Professor**  
Medical imaging physics, high energy particle physics, accelerator physics

Harsh Mathur, PhD  
(Yale University)  
**Professor**  
Condensed matter theory, particle-astrophysics theory

Benjamin Monreal, PhD  
(Massachusetts Institute of Technology)  
**Agnar Pytte Professor in Physics; Associate Professor**  
Experimental particle astrophysics

Rolfe G. Petschek, PhD  
(Harvard University)  
**Professor**  
Theoretical condensed matter; optical materials

Charles Rosenblatt, PhD  
(Harvard University)  
**Professor and Ohio Eminent Scholar in Condensed Matter Physics**  
Experimental condensed matter; liquid crystals and complex fluids

John E. Ruhl, PhD  
(Princeton University)  
**Connecticut Professor**  
Experimental astrophysics and cosmology

Kenneth D. Singer, PhD  
(University of Pennsylvania)  
**Ambrose Swasey Professor of Physics; Director, Engineering Physics**  
Experimental condensed matter physics; nonlinear optics

Glenn D. Starkman, PhD  
(Stanford University)  
**Distinguished University Professor; Director, Institute for the Science of Origins; Director, Center for Education and Research in Cosmology and Astrophysics (CERCA)**  
Theoretical cosmology, particle physics, astrophysics

Giuseppe Strangi, PhD  
(University of Calabria, Italy)  
**Professor and The Ohio Research Scholar in Surfaces of Advanced Materials**  
Opto-plasmonics of soft composite metamaterials; liquid crystal photonics

Cyrus C. Taylor, PhD  
(Massachusetts Institute of Technology)  
**Albert A. Michelson Professor in Physics; Dean, College of Arts and Sciences**  
Theoretical and experimental particle physics; physics entrepreneurship

Philip L. Taylor, PhD  
(University of Cambridge)  
**Distinguished University Professor and Perkins Professor of Physics**  
Theory of solids, polymers and other materials

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**Visiting Faculty**

Bryan W. Lynn, PhD  
(Columbia University)  
**Visiting Professor**  
Theoretical particle physics

Emanuela Dimastrogiovanni, PhD  
(University of Padova)  
**Assistant Professor**  
Theoretical particle physics; astrophysics; cosmology

---

**Secondary Faculty**

Roger H. French, PhD  
(Massachusetts Institute of Technology)  
**F. Alex Nason Professor, Department of Materials Science and Engineering, Case School of Engineering**  
Optical materials and technologies; experimental VIS/UV/VUV optical properties and long range interactions

Mark A. Griswold, PhD  
(University of Wuerzburg)  
**Professor, Department of Radiology, School of Medicine**  
Medical imaging, MRI

Eckhard Jankowsky, PhD  
(Dresden Institute of Technology)  
**Associate Professor, Department of Biochemistry, School of Medicine**  
Proteins and enzymes; structural biology; regulation of gene expression

R. Earle Luck, PhD  
(University of Texas at Austin)  
**Worcester R. and Cornelia B. Warner Professor of Astronomy, Department of Astronomy**  
Stellar and galactic chemical evolution; stellar spectrophotometry

Stacy S. McGaugh, PhD  
(University of Michigan)  
**Professor, Department of Astronomy**  
Galaxy formation and evolution, low surface brightness galaxies, cosmology, dark matter, and gravity

J. Christopher Mihos, PhD  
(University of Michigan)  
**Professor, Department of Astronomy**  
Galaxy formation and evolution; galaxy interactions; clusters of galaxies; observational and computational astrophysics
Heather Morrison, PhD
(Australian National University)
Professor, Department of Astronomy
Galactic structure; stellar populations; dark matter

Idit Zehavi, PhD
(Hebrew University of Jerusalem)
Associate Professor, Department of Astronomy
Astrophysics

Adjunct Faculty

Daniel S. Akerib, PhD
(Princeton University)
Adjunct Professor
Experimental astrophysics

James H. Andrews, PhD
(Case Western Reserve University)
Adjunct Professor, Professor of Physics, Youngstown State University
Optical materials

Pierre Carliès, PhD, Habilitation
(National Polytechnic Institute, Toulouse)
Adjunct Associate Professor, Associate Professor, Université Pierre et Marie Curie, Paris
Fluid mechanics; critical behavior; stability

Claudia de Rham, PhD
(University of Cambridge)
Associate Professor
Massive gravity and degravitation; Supersymmetric Large Extra Dimensions (SLED); physics of codimension-2 objects; cosmological perturbations

Jeffrey S. Dyck, PhD
(Case Western Reserve University)
Adjunct Professor, Professor, John Carroll University
Experimental condensed matter physics

Karsten Eggert, PhD
(RWTH Aachen University)
Adjunct Professor
Experimental particle physics; cosmic ray physics; diffractive physics; TOTEM experiment at CERN

Hiroyuki Fujita, PhD
(Case Western Reserve University)
Adjunct Professor, President and CEO, Quality Electrodynamics and eQED
Hardware technology in imaging and renewable energies

E. Mark Haacke, PhD
(University of Toronto)
Adjunct Professor; Professor, Wayne State University
Physics of imaging; experimental biophysics

Daeseung Kang, PhD
(Case Western Reserve University)
Adjunct Associate Professor
Experimental condensed matter; liquid crystal

Emmanuelle Lacaze, PhD
(Université Denis Diderot - Paris VII, Université Pierre et Marie Curie - Paris VI)
Adjunct Professor
Experimental condensed matter; soft materials

Timothy Peshek, PhD
(Case Western Reserve University)
Adjunct Assistant Professor
Experimental semiconductor physics

Jie Shan, PhD
(Columbia University)
Adjunct Associate Professor
Experimental condensed matter physics; ultrafast optics; terahertz spectroscopy

Irina Shyianovskaya, PhD
(Institute of Physics, National Academy of Science of Ukraine)
Adjunct Associate Professor; Kent Displays, Inc.
Experimental condensed matter physics

Thomas A. Shutt, PhD
(University of California, Berkeley)
Adjunct Professor
Experimental astrophysics

Shmaryu Shvartsman, PhD
(Tomsk State University)
Adjunct Professor, Principal Scientist, ViewRay, Inc.
General physics research and development

Mano Singham, PhD
(University of Pittsburgh)
Adjunct Associate Professor
Particle physics; physics teaching

Michael Thompson, PhD
(Case Western Reserve University)
Adjunct Assistant Professor, Director of Research, Development, and Advanced Applications, AllTech Medical Systems America
MRI signal acquisition

Andrew Tolley, PhD
(University of Cambridge)
Associate Professor
Experimental astrophysics

Mesfin Tsige, PhD
(Case Western Reserve University)
Adjunct Associate Professor
Theory of solids; polymers and other materials

Theory of solids; polymers and other materials
Courses
PHYS 113A. Principles of Physics Laboratory - Mechanics. 1 Unit.
The laboratory portion of first semester introductory physics.

PHYS 113B. Principles of Physics Laboratory - Electricity and Magnetism. 1 Unit.
The laboratory portion of the second semester of physics.

PHYS 115. Introductory Physics 1. 4 Units.
First part of a two-semester sequence directed primarily towards students working towards a B.A. in science, with an emphasis on the life sciences. Kinematics; Newton’s laws; gravitation; simple harmonic motion; mechanical waves; fluids; ideal gas law; heat and the first and second laws of thermodynamics. This course has a laboratory component. Students may earn credit for only one of the following courses: PHYS 115, PHYS 121, PHYS 123.

PHYS 116. Introductory Physics II. 4 Units.
Electricity, Coulomb’s law, Gauss’s law; capacitance and resistance; DC circuits; magnetic fields; electromagnetic induction; RC and RL circuits; light; geometrical optics; interference and diffraction; special relativity; introduction to quantum mechanics; elements of atomic, nuclear and particle physics. This course has a laboratory component. Students may earn credit for only one of the following courses: PHYS 116, PHYS 122, PHYS 124. Prereq: PHYS 115.

PHYS 121. General Physics I - Mechanics. 4 Units.
Particle dynamics, Newton’s laws of motion, energy and momentum conservation, rotational motion, and angular momentum conservation. This course has a laboratory component. Recommended preparation: MATH 121 or MATH 123 or MATH 125 or one year of high school calculus. Students who do not have the appropriate background should not enroll in PHYS 121 without first consulting the instructor. Students may earn credit for only one of the following courses: PHYS 115, PHYS 121, PHYS 123.

PHYS 122. General Physics II - Electricity and Magnetism. 4 Units.
Electricity and magnetism, emphasizing the basic electromagnetic laws of Gauss, Ampere, and Faraday. Maxwell’s equations and electromagnetic waves, interference, and diffraction. This course has a laboratory component. Students may earn credit for only one of the following courses: PHYS 116, PHYS 122, PHYS 124. Prereq: PHYS 121 or PHYS 123. Prereq or Coreq: MATH 122 or MATH 124 or MATH 126.

PHYS 123. Physics and Frontiers I - Mechanics. 4 Units.
The Newtonian dynamics of a particle and of rigid bodies. Energy, momentum, and angular momentum conservation with applications. A selection of special frontier topics as time permits, including fractals and chaos, special relativity, fluid mechanics, cosmology, quantum mechanics. This course has a laboratory component. Admission to this course is by invitation only. Students may earn credit for only one of the following courses: PHYS 115, PHYS 121, PHYS 123.

PHYS 124. Physics and Frontiers II - Electricity and Magnetism. 4 Units.
Time-independent and time-dependent electric and magnetic fields. The laws of Coulomb, Gauss, Ampere, and Faraday. Microscopic approach to dielectric and magnetic materials. Introduction to the usage of vector calculus; Maxwell’s equations in integral and differential form. The role of special relativity in electromagnetism. Electromagnetic radiation. This course has a laboratory component. Students may earn credit for only one of the following courses: PHYS 116, PHYS 122, PHYS 124. Prereq: PHYS 123. Prereq or Coreq: MATH 122 or MATH 124.

PHYS 166. Physics Today and Tomorrow. 1 Unit.
This course will provide students with an opportunity to learn about the most exciting and timely research areas in physics, as well as other topics germane to being a professional physicist. These discussions will cover fields such as nanoscience, ultrafast optics, exotic materials, biophysics, cosmology, string theory and the role of physicists in developing new technologies. Each week a member of the faculty will meet with students to discuss a topic of current interest, how a physicist approaches the problem, and how physicists interact with others to find a solution. Other topics germane to being a professional physicist also will be discussed, including the relationships among academic, industrial, and governmental laboratories; ethics, and non-traditional careers for students trained in physics.

PHYS 203. Analog and Digital Electronics. 4 Units.
Elements of both analog and digital electronics from the practical viewpoint of the experimental scientist; AC circuits, linear and non-linear operation of op-amps, logic gates, flip-flops, counters, display, memory, transducers, A/D and D/A conversion. Laboratory work involves quantitative investigation of the operation of all these elements, together with projects that explore their combination. Recommended preparation: PHYS 122 or PHYS 124.

PHYS 204. Advanced Instrumentation Laboratory. 4 Units.
Principles of experimental design; limits of resolution via band-width, thermal noise, background signals; data acquisition and control by computer; computer simulation; signal processing techniques in frequency and time domains, FFT, correlations, and other transform methods; counting techniques. Applications include lock-in amplifiers, digitizing oscilloscopes and data acquisition systems. Recommended preparation: PHYS 203 and PHYS 221.

PHYS 208. Instrumentation and Signal Analysis Laboratory. 4 Units.
AC circuit theory, Fourier series, discrete Fourier series. Fourier integral, discrete Fourier integral; analysis in time and frequency domains, correlation, cross-correlation and other transform techniques; computer control of experiments via IEEE488 interface; advanced instrumentation; DMM, arbitrary waveform generator; multiplexing and digitizing oscilloscopes; experimental design, noise; design, construction, and testing of a lock-in amplifier. Recommended preparation: PHYS 221.

PHYS 221. Introduction to Modern Physics. 3 Units.
Concepts in special relativity, statistical mechanics and quantum mechanics. Applications to atomic structure, and selected topics in nuclear, condensed matter physics, particle physics, and cosmology. Prereq: PHYS 116 or PHYS 122 or PHYS 124.

PHYS 250. Computational Methods in Physics. 3 Units.

PHYS 301. Advanced Laboratory Physics I. 3 Units.
Problem solving approach with a range of available experiments in classical and modern physics. Emphasis on experimental techniques, data and error analysis, and the formal presentation of the work performed. Recommended preparation: PHYS 204. Coreq: PHYS 303.
PHYS 302. Advanced Laboratory Physics II. 4 Units.
Several projects using research-quality equipment in contemporary fields of experimental physics. Each requires reading appropriate literature, choosing appropriate instrumentation, performing data acquisition and analysis, and writing a technical paper. Topics include particle counting techniques, neutron activation, gamma-ray spectroscopy, a range of condensed matter experiments including temperature dependent properties between 10 and 350 K, modern optics, ultrahigh vacuum surface science. Recommended preparation: PHYS 301.

PHYS 303. Advanced Laboratory Physics Seminar. 1 Unit.
Students will discuss various issues associated with physics research. These include how to judge the quality of an experiment and data (error analysis), how to present your work in written and oral formats, safety and ethical concerns in the laboratory. Recommended preparation: PHYS 250. Counts as SAGES Departmental Seminar.

PHYS 310. Classical Mechanics. 3 Units.
Lagrangian formulation of mechanics and its application to central force motion, scattering theory, rigid body motion, and systems of many degrees of freedom. Recommended preparation: PHYS 221 and either MATH 223 or MATH 227.

PHYS 313. Thermodynamics and Statistical Mechanics. 3 Units.

PHYS 315. Introduction to Solid State Physics. 3 Units.
Characterization and properties of solids; crystal structure, thermal properties of lattices, quantum statistics, electronic structure of metals and semiconductors. PHYS 415 for graduate students in engineering and science. (May not be taken for departmental credit by graduate students in the Department of Physics.) Prerequisite may be waived with consent of department. Recommended preparation for PHYS 415: PHYS 331. Offered as PHYS 315 and PHYS 415. Prereq: PHYS 331 or PHYS 481.

PHYS 316. Introduction to Nuclear and Particle Physics. 3 Units.
The physics of nuclei and elementary particles; experimental methods used to determine their properties; models and theories developed to describe their structure. Prereq: PHYS 331 or PHYS 481.

PHYS 317. Engineering Physics Laboratory I. 3 Units.
Laboratory course for engineering physics majors. Emphasis is on experimental techniques, data and error analysis, and written and oral presentation of work. Four experiments drawn from classical and modern physics are carried out. These emphasize condensed matter, material and optical physics. Experiments include electric fields, resistivity of materials, optical interference, chaotic systems, and spectroscopy. Design of data analysis systems and software is required. Prereq: PHYS 208. Coreq: PHYS 303.

PHYS 318. Engineering Physics Laboratory II. 4 Units.
Laboratory course for engineering physics majors. Several projects using research-quality equipment in contemporary fields of experimental physics. Open-ended experiments each require reading appropriate literature, designing the experiment, performing data analysis, and writing a technical paper. Topics are drawn from areas of modern physics, and concentrate on condensed matter, material, and optical physics. Prereq: PHYS 317.

PHYS 320. Introduction to Biological Physics. 3 Units.
This course explores the intersection of physics and biology: how do fundamental physical laws constrain life processes inside the cell, shaping biological organization and dynamics? We will start at the molecular level, introducing the basic ideas of nonequilibrium statistical physics and thermodynamics required to describe the fluctuating environment of the cell. This will also examine how to verify these models through the rich toolbox of biophysical experimental and computational technologies. The course should be accessible to students from diverse backgrounds in the physical and life sciences: we will explain both the biological details and develop the necessary mathematical / physical ideas in a self-contained manner. Offered as PHYS 320 and PHYS 420. Prereq: (MATH 122 or MATH 124) and (ENGR 131 or EECS 132).

PHYS 324. Electricity and Magnetism I. 3 Units.
First half of a sequence that constitutes a detailed study of the basics of electromagnetic theory and many of its applications. Electrostatics and magnetostatics of free space, conductors, dielectric and magnetic materials; basic theory illustrated with applications drawn from condensed matter physics, optics, plasma physics, and physical electronics. Prereq: PHYS 116 or PHYS 122 or PHYS 124.

PHYS 325. Electricity and Magnetism II. 3 Units.
(Continuation of PHYS 324.) Electrodynamics, Maxwell's equations, electromagnetic waves, electromagnetic radiation and its interaction with matter, potential formulation of electromagnetism, and relativity. Prereq: PHYS 324.

PHYS 326. Physical Optics. 3 Units.
Geometrical optics and ray tracing, wave propagation, interaction of electromagnetic radiation with matter, interference, diffraction, and coherence. Supplementary current topics from modern optics such as nonlinear optics, holography, optical trapping and optical computing. Prerequisite(s) may be waived with consent of department. Offered as PHYS 326 and PHYS 426. Prereq: PHYS 122 or PHYS 124.

PHYS 327. Laser Physics. 3 Units.
An introduction to theoretical and practical quantum electronics covering topics in quantum optics, laser physics, and nonlinear optics. Topics to be addressed include the physics of two-level quantum systems including the density matrix formalism, rate equations, and semiclassical radiation theory; laser operation including oscillation, gain, resonator optics, transverse and longitudinal modes, Q-switching, mode-locking, and coherence; and nonlinear optics including the nonlinear susceptibility, parametric interactions, stimulated processes, and self-action. Recommended preparation for PHYS 427: PHYS 331 or PHYS 481. Offered as PHYS 327 and PHYS 427. Prereq: PHYS 331 or PHYS 481.

PHYS 328. Cosmology and the Structure of the Universe. 3 Units.

PHYS 329. Independent Study. 1 - 4 Units.
An individual reading course in any topic of mutual interest to the student and the faculty supervisor.
PHYS 331. Introduction to Quantum Mechanics I. 3 Units.
Quantum nature of energy and angular momentum, wave nature of matter, Schroedinger equation in one and three dimensions; matrix methods; Dirac notation; quantum mechanical scattering. Two particle wave functions. Prereq: PHYS 221.

PHYS 332. Introduction to Quantum Mechanics II. 3 Units.
Continuation of PHYS 331. Spin and fine structure; Dirac equation; symmetries; approximation methods; atomic and molecular spectra; time dependent perturbations; quantum statistics; applications to electrons in metals and liquid helium. Prereq: PHYS 331.

PHYS 333. Modern Cosmology. 3 Units.
An introduction to modern cosmology and an exploration of current topics in the field. The first half of the course will cover the mathematical and physical basis of cosmology, while the second will delve into current questions and the observations that constrain them. Offered as PHYS 336 and PHYS 436. Prereq: PHYS 221.

PHYS 339. Seminar. 1 - 3 Units.
Conducted in small sections with presentation of papers by students and informal discussion. Special problem seminars and research seminars offered according to interest and need, often in conjunction with one or more research groups.

PHYS 349. Methods of Mathematical Physics I. 3 Units.
Analysis of complex functions: singularities, residues, contour integration; evaluation and approximation of sums and integrals; exact and approximate solution of ordinary differential equations; transform calculus; Sturm-Liouville theory; calculus of variations. Additional work required for graduate students. Offered as PHYS 349 and PHYS 449. Prereq: MATH 224.

PHYS 350. Methods of Mathematical Physics II. 3 Units.
(Continuation of PHYS 349/449.) Special functions, orthogonal polynomials, partial differential equations, linear operators, group theory, tensors, selected specials topics. Additional work required for graduate students. Prereq: PHYS 349.

PHYS 351. Senior Physics Project. 2 Units.
A two semester course required for senior BS and BA physics majors. Students pursue a project based on experimental, theoretical or teaching research under the supervision of a physics faculty member, a faculty member from another CWRU department or a research scientist or engineer from another institution. A departmental Senior Project Committee must approve all project proposals and will receive regular oral and written progress reports. Final results are presented at the end of the second semester as a paper in a style suitable for publication in a professional journal as well as an oral report in a public symposium. Counts as SAGES Senior Capstone. Prereq: PHYS 318. Coreq: PHYS 352.

PHYS 352. Senior Physics Project Seminar. 1 Unit.
This two semester seminar is taken concurrently with the student's two semester senior project. Students meet weekly to discuss their projects and the research experience. The class will include dialogues about professional issues such as ethics, graduate school, jobs, funding, professional organizations, public obligations, writing and speaking. Assignments include proposals, progress reports and posters. Counts as SAGES Departmental Seminar. Coreq: PHYS 351 or PHYS 353.

PHYS 353. Senior Engineering Physics Project. 2 Units.
A two semester course required for BSE Engineering Physics majors. Students are expected to complete a research project in their concentration area under the supervision of a faculty member in science, engineering, or, with approval, a researcher at another institution or company. The project may be calculational, experimental or theoretical, and will address both the underlying physics and appropriate engineering and design principles. A program Senior Project Committee must approve all project proposals and will receive regular oral and written progress reports. Final results are presented at the end of the second semester as a paper in a style suitable for publication in a professional journal as well as an oral report in a public symposium. Counts as SAGES Senior Capstone. Prereq: PHYS 318. Coreq: PHYS 352.

PHYS 356. General Relativity. 3 Units.
This is an introductory course in general relativity. The techniques of tensor analysis will be developed and used to describe the effects of gravity and Einstein's theory. Consequences of the theory as well as its experimental tests will be discussed. An introduction to cosmology will be given. Additional work required for graduate students. Offered as PHYS 365 and PHYS 465.

PHYS 390. Undergraduate Research in Physics. 3 - 6 Units.
Research conducted under the supervision of a faculty member in the Department of Physics. Arrangements must be made with a faculty member and a written description of these arrangements must be submitted to and approved by the department before a permit will be issued to register for this course. A final report must be supplied to the department at the end of the semester.

PHYS 413. Classical and Statistical Mechanics I. 3 Units.
An integrated approach to classical and statistical mechanics. Lagrangian and Hamiltonian formulations, conservation laws, kinematics and dynamics, Poisson brackets, continuous media, derivation of laws of thermodynamics, the development of the partition function. To be followed by PHYS 414.

PHYS 414. Classical and Statistical Mechanics II. 3 Units.
A continuation of PHYS 413. Noninteracting systems, statistical mechanics of solids, liquids, gases, fluctuations, irreversible processes, phase transformations. Recommended preparation: PHYS 413 or consent of department.

PHYS 415. Introduction to Solid State Physics. 3 Units.
Characterization and properties of solids; crystal structure, thermal properties of lattices, quantum statistics, electronic structure of metals and semiconductors. PHYS 415 for graduate students in engineering and science. (May not be taken for departmental credit by graduate students in the Department of Physics.) Prerequisite may be waived with consent of department. Recommended preparation for PHYS 415: PHYS 331. Offered as PHYS 315 and PHYS 415.
PHYS 420. Introduction to Biological Physics. 3 Units.
This course explores the intersection of physics and biology: how do fundamental physical laws constrain life processes inside the cell, shaping biological organization and dynamics? We will start at the molecular level, introducing the basic ideas of nonequilibrium statistical physics and thermodynamics required to describe the fluctuating environment of the cell. This allows us to build up a theoretical framework for a variety of elaborate cellular machines: the molecular motors driving cell movement, the chaperones that assist protein folding, the information-processing circuitry of genetic regulatory networks. The emphasis throughout will be on simple, quantitative models that can tackle the inherent randomness and variability of cellular phenomena. We will also examine how to verify these models through the rich toolbox of biophysical experimental and computational technologies. The course should be accessible to students from diverse backgrounds in the physical and life sciences: we will explain both the biological details and develop the necessary mathematical / physical ideas in a self-contained manner. Offered as PHYS 320 and PHYS 420. Prereq: Graduate student standing.

PHYS 423. Classical Electromagnetism. 3 Units.

PHYS 426. Physical Optics. 3 Units.
Geometrical optics and ray tracing, wave propagation, interaction of electromagnetic radiation with matter, interference, diffraction, and coherence. Supplementary current topics from modern optics such as nonlinear optics, holography, optical trapping and optical computing. Prerequisite(s) may be waived with consent of department. Offered as PHYS 326 and PHYS 426.

PHYS 427. Laser Physics. 3 Units.
An introduction to theoretical and practical quantum electronics covering topics in quantum optics, laser physics, and nonlinear optics. Topics to be addressed include the physics of two-level quantum systems including the density matrix formalism, rate equations, and semiclassical radiation theory; laser operation including oscillation, gain, resonator optics, transverse and longitudinal modes, Q-switching, mode-locking, and coherence; and nonlinear optics including the nonlinear susceptibility, parametric interactions, stimulated processes, and self-action. Recommended preparation for PHYS 427: PHYS 319 or PHYS 419. Offered as PHYS 327 and PHYS 427.

PHYS 428. Cosmology and the Structure of the Universe. 3 Units.

PHYS 431. Physics of Imaging. 3 Units.
Description of physical principles underlying the spin behavior in MR and Fourier imaging in multi-dimensions. Introduction of conventional, fast, and chemical-shift imaging techniques. Spin echo, gradient echo, and variable flip-angle methods. Projection reconstruction and sampling theorems. Bloch equations, T1 and T2 relaxation times, rf penetration, diffusion and perfusion. Flow imaging, MR angiography, and functional brain imaging. Sequence and coil design. Prerequisite may be waived with consent of instructor. Recommended preparation: PHYS 122 or PHYS 124 or EBME 410. Offered as EBME 431 and PHYS 431.

PHYS 436. Modern Cosmology. 3 Units.
An introduction to modern cosmology and an exploration of current topics in the field. The first half of the course will cover the mathematical and physical basis of cosmology, while the second will delve into current questions and the observations that constrain them. Offered as PHYS 336 and PHYS 436.

PHYS 441. Physics of Condensed Matter I. 3 Units.
Crystal structure, x-ray diffraction, band theory and applications. Free electron theory of metals and electrons in magnetic fields.

PHYS 442. Physics of Condensed Matter II. 3 Units.
Continuation of PHYS 441. Lattice vibrations, thermal properties of solids, semiconductors, magnetic properties of solids, and superconductivity. Prerequisite may be waived with consent of department. Recommended preparation: PHYS 441.

PHYS 449. Methods of Mathematical Physics I. 3 Units.
Analysis of complex functions: singularities, residues, contour integration; evaluation and approximation of sums and integrals; exact and approximate solution of ordinary differential equations; transform calculus; Sturm-Liouville theory; calculus of variations. Additional work required for graduate students. Offered as PHYS 349 and PHYS 449.

PHYS 451. Empirical Foundations of the Standard Model. 3 Units.
The experimental basis for modeling the electroweak and strong interactions in terms of fundamental fermions, quarks and leptons, and gauge bosons, photons, the weak bosons, and gluons; particle accelerators and detection techniques; phenomenology of particle reactions, decays and hadronic structure; space, time and internal symmetries; symmetries; symmetry breaking.

PHYS 460. Advanced Topics in NMR Imaging. 3 Units.
Frontier issues in understanding the practical aspects of NMR imaging. Theoretical descriptions are accompanied by specific examples of pulse sequences, and basic engineering considerations in MRI system design. Emphasis is placed on implications and trade-offs in MRI pulse sequence design from real-world versus theoretical perspectives. Recommended preparation: EBME 431 or PHYS 431. Offered as EBME 460 and PHYS 460. Prereq: Graduate standing or Undergraduate with Junior or Senior standing and a cumulative GPA of 3.2 or above.

PHYS 465. General Relativity. 3 Units.
This is an introductory course in general relativity. The techniques of tensor analysis will be developed and used to describe the effects of gravity and Einstein's theory. Consequences of the theory as well as its experimental tests will be discussed. An introduction to cosmology will be given. Additional work required for graduate students. Offered as PHYS 365 and PHYS 465.

PHYS 472. Graduate Physics Laboratory. 3 Units.
A series of projects designed to introduce the student to modern research techniques such as automated data acquisition. Students will be assessed as to their individual needs and a sequence of projects will be established for each individual. Topics may include low temperature phenomena, nuclear gamma ray detection and measurement and optics.

PHYS 481. Quantum Mechanics I. 3 Units.
Quantum mechanics with examples of applications. Schroedinger method; matrix and operator methods. Approximation methods including WKB, variational and various perturbation methods. Applications to atomic, molecular and nuclear physics including both bound states and scattering problems. Applications of group theory to quantum mechanics.
PHY 482. Quantum Mechanics II. 3 Units.
Continuation of PHYS 481, including quantum field theory. Prerequisite may be waived with consent of department. Recommended preparation: PHYS 481 or consent of department.

PHY 491. Modern Physics for Innovation I. 3 Units.
The first half of a two-semester sequence providing an understanding of physics as a basis for successfully launching new tech-ventures. The course will examine physical limitations to present technologies, and the use of physics to identify potential opportunities for new venture creation. The course will provide experience in using physics for both identification of incremental improvements, and as the basis for alternative technologies. Case studies will be used to illustrate recent commercially successful and unsuccessful physics-based venture creation, and will illustrate characteristics for success.

PHY 492. Modern Physics for Innovation II. 3 Units.
Continuation of PHYS 491, with an emphasis on current and prospective opportunities for Physics Entrepreneurship. Longer term opportunities for Physics Entrepreneurship in emerging areas including, but not limited to, nanoscale physics and nanotechnology, biophysics and applications to biotechnology, physics-based opportunities in the context of information technology. Recommended preparation: PHYS 491.

PHY 493. Feasibility and Technology Analysis. 3 Units.
This course provides the tools scientists need to determine whether a technology is ready for commercialization. These tools include (but are not limited to): financial analysis, market analysis, industry analysis, technology analysis, intellectual property protection, the entrepreneurial process and culture, an introduction to entrepreneurial strategy and new venture financing. Deliverables will include a technology feasibility analysis on a possible application in the student’s scientific area. Offered as BIOL 493, CHEM 493, and PHYS 493.

PHY 494. Technology-Based Venture Creation. 3 Units.
This course provides the advanced tools needed to develop, articulate, and launch a venture plan for a technology identified as likely to be successful through a feasibility analysis. Additional topics include: entrepreneurial strategy, communication, sales, negotiation, entrepreneurial finance, and leadership in an entrepreneurial environment. Guest speakers will be featured in nearly every class session. Prereq: BIOL 493 or CHEM 493 or PHYS 493.

PHY 539. Special Topics Seminar. 1 - 3 Units.
Individual or small group instruction on topics of interest to the department. Topics include, but are not limited to, particle physics, astrophysics, optics, condensed matter physics, biophysics, imaging. Several such courses may run concurrently.

PHY 566. Cosmology. 3 Units.
Introduction to our current understanding of the origin and evolution of the Universe and connection between our understanding of elementary particle physics and cosmology. Specific topics will include: General Parameters of Cosmology: Expansion, Lifetime, and Density of the Universe. The Early Universe, Constraints on Elementary Particles, Dark Matter and Dark Energy, Nucleosynthesis, Cosmic Microwave Background, Inflation, Stellar Evolution, Gravitational Waves, Baryogenesis. Some background in general relativity and particle physics phenomenology is recommended.

PHY 581. Quantum Mechanics III. 3 Units.

PHY 591. Gauge Field Theory I. 3 Units.
Noether’s theorem, symmetries and conserved currents, functional integral techniques, quantization, Feynman rules, anomalies, QED, electroweak interactions, QCD, renormalization, renormalization group, asymptotic freedom and assorted other topics. Prereq: PHYS 581.

PHY 601. Research in Physics. 1 - 9 Units.

PHY 651. Thesis M.S.. 1 - 9 Units.

PHY 666. Frontiers in Physics. 0 Unit.
Weekly colloquia given by eminent physicists from around the world on topics of current interest in physics.

PHY 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Political Science

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Karen Beckwith, Department Chair
karen.beckwith@case.edu

The study of political science is primarily concerned with political power, governance, and the state, broadly understood. Our department offers courses that explore political behavior, institutions of government, international relations and international finance, policy-making, and protest and revolution. Our political science faculty employ a range of research methods and approaches, including elite interviewing, survey research, field and archival research, and comparative case study analysis.

Faculty specialties in the Department of Political Science include US political institutions; elections and political parties both in the United States and abroad; legislative politics and public policy; international relations with an emphasis on international political economy; the development and decline of nation-states; the politics of gender; constitutional law; public policy and public organizations; research methods; and comparative politics with regional concentrations including Africa, Central Asia and the Middle East, and Europe. The department offers degree programs leading to the BA, MA, and PhD.

The study of political science can build a foundation for many types of future employment. Many political science majors are preparing for graduate study or law school. Others intend to pursue careers in journalism, nonprofit groups, public policy, government, or business.

Undergraduate Programs

Major
The major in political science leads to the Bachelor of Arts degree. The major requires 30 hours of course work, distributed as follows:

Required Courses:
Students select courses based on their specific interests, with approval of the faculty advisor. No more than six hours of independent study (i.e., POSC 395 Special Projects and/or POSC 396 Senior Project SAGES Capstone) may count toward the major. Independent study completed through the Washington Center Program is excluded from this limitation.

**Departmental Honors**

Majors who maintain a grade point average of at least 3.3 overall on completion of senior year and 3.7 in political science courses, and who earn a grade of A in POSC 396 Senior Project SAGES Capstone, will be eligible to be nominated to receive their degrees “with Honors in Political Science.”

**Integrated Graduate Studies**

The Integrated Graduate Studies (IGS) Program (p. 1078) in political science offers students the opportunity to earn an MA, in addition to their BA, within the usual period of undergraduate study or with a small amount of extra time. Students should notify the department of their interest no later than the beginning of the first semester of the junior year. Further application procedures are posted on the department’s website. Upon completion of 90 undergraduate hours, the student must have satisfied all general requirements for the BA, including at least 21 hours in the political science major and the General Education Requirements, and must have a 3.5 grade point average in political science courses and 3.3 overall. If admitted to the IGS program, the student will take 30 hours of graduate-level political science courses during the senior year, adhering to the departmental regulations governing the master’s degree program. If completed successfully, these hours will count simultaneously toward both degrees in political science.

The BA will be awarded upon completion of all requirements for that degree, including total hours. The MA will be awarded upon successful completion of the 30 hours of graduate-level courses and the MA examination or thesis.

**Minor**

**Political Science**

A minor in political science consists of 15 hours (five courses) in the department, of which 9 hours must be at the 300 level. An elected minor sequence must be approved by a political science faculty advisor.

**Public Policy**

A minor in public policy is available to undergraduates in the College of Arts and Sciences and to undergraduates in the economics and management programs in the Weatherhead School of Management. Please see the Public Policy Program’s (p. 497) section of the bulletin for details.

**Graduate Programs**

**Master of Arts**

Applicants to the Master of Arts program in political science are required to submit their undergraduate transcripts and three letters of recommendation from former instructors. The admission requirements also include GRE results with minimum scores of 153 on Verbal (or 500 if taken before August 1, 2011), 144 on Quantitative (or 500 if taken before August 1, 2011), and 4.5 on Analytical sections. The department strongly prefers that applicants have a minimum GPA of 3.2 overall and a minimum GPA of 3.4 in political science courses. For students from other countries, the requirements are a minimum score of 550 on the paper version of the Test of English as a Foreign Language (TOEFL), or at least 215 on the computer version of the TOEFL; the minimum GRE scores indicated above; and transcripts of all undergraduate study, indicating completion of a Bachelor of Arts or Bachelor of Science degree program.

In addition to coursework, students complete the Master of Arts program in political science either through a thesis (Graduate School Plan A) or a comprehensive examination (Graduate School Plan B), as described below.

The Master of Arts in political science is a broadly based program in which the student is expected to acquire and exhibit general knowledge and skills. Therefore, within the 30 hours of graduate-level course work (400 level and above) required for the master’s, 12 hours must be distributed as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>One course in the area of American government and politics</td>
<td>3</td>
</tr>
<tr>
<td>One course in the area of comparative politics</td>
<td>3</td>
</tr>
<tr>
<td>One course in the area of international relations</td>
<td>3</td>
</tr>
<tr>
<td>POSC 449 Political Science Research Methods</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Units</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

Students who receive permission (due to special circumstances) from the graduate coordinator may take an alternative research methods course outside the department.

Among the remaining 18 hours of electives, the student will select courses to fit a plan to complete a thesis (in Plan A below) or complete an examination in two fields (Plan B below), as approved by the graduate studies director. A maximum of 9 hours may be taken outside the Department of Political Science, with prior approval from the graduate studies director, for specialized work related to the master’s degree for which no political science course is appropriate. A maximum of nine hours of independent study (POSC 601 Individual Investigation) may count toward the degree.

A minimum grade point average of 3.0 must be maintained throughout the Master of Arts program. A master’s student who fails to maintain a GPA of 3.0 will be placed on academic probation for one semester. If the GPA is not returned to the 3.0 minimum by the end of the probationary semester, the student will be separated from further study in the department.

**Plan A: MA Thesis**

An MA Thesis should be a major research paper equivalent to at least six hours of registration. Students shall register for POSC 651 Thesis M.A., which will count towards the 30 hours of coursework required for completion of the MA. An MA Thesis will be read by a committee of three members of the faculty, and defended in an oral examination with the faculty committee. The committee shall vote on approval of the thesis after the oral defense. A majority vote will suffice to approve the thesis.

Students must define their thesis topic no later than the last week of the semester before the semester in which they expect to defend the thesis.

**Graduate Programs**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>POSC 109 The U.S. Political System</td>
<td></td>
</tr>
<tr>
<td>POSC 160 Introduction to Comparative Politics</td>
<td></td>
</tr>
<tr>
<td>POSC 172 Introduction to International Relations</td>
<td></td>
</tr>
<tr>
<td>Six POSC courses at the 300 level</td>
<td>18</td>
</tr>
<tr>
<td>POSC 396 Senior Project SAGES Capstone</td>
<td></td>
</tr>
<tr>
<td><strong>Total Units</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>
The thesis supervisor will be selected by mutual agreement between the student and the faculty member who agrees to supervise. The topic must be defined before the student registers for POSC 651 Thesis M.A., and a permit for the course must be issued by the faculty supervisor. The student must prepare a prospectus describing the research question and research plans before the permit can be issued. The prospectus must be approved by both the faculty supervisor and the department’s graduate studies director. The director shall appoint the two other members of the examination committee. The graduate studies director will also schedule the oral defense, with assistance from the department staff.

**Plan B: MA Examination**

For the MA Examination, students should be able to explain, critique, integrate and apply the arguments of leading works in two out of the three fields of American Politics and Government, Comparative Politics, and International Relations. The examination is a written test of five hours’ duration, with 150 minutes for each of the chosen subfields. A student who chooses Plan B must request scheduling of the examination upon completion of no fewer than 30 hours and no more than 42 hours of master’s-level course work.

The examination is administered in a controlled, closed-book setting. The department maintains, on its website, MA reading lists of major scholarly works within the three fields listed above, and test questions will be based upon an expectation that the student has thoroughly studied – whether in or outside of classes – the works designated on those lists. Faculty members within each subfield write the questions for that subfield, which are then assembled by the graduate studies director, who is responsible for scheduling the exam.

The student must notify his or her faculty advisor and the graduate studies director of intent to take the exam, and the two subfields chosen, at least six weeks before he or she wishes to take it. Each section of the examination will be graded by two members of the faculty. The two faculty members must agree that the student has performed acceptably on that section of the examination in order for the student to pass on that section. The student must pass both sections to pass the exam.

Grading for the exam is Honors, Pass, or Fail. If the exam is failed, a student will have one calendar year in which to retake the exam. We expect the student will need at least one semester to prepare for retaking the exam. During the interim, the political science faculty may require the student to take additional classes to help address the concerns raised by the failed exam segment or segments. If the student does not pass the exam on a second attempt, she or he will be separated from the department. Please note that university regulations require PhD students to spend at least one academic year in full-time residence (two consecutive regular semesters with a minimum of 9 hours’ registration each semester).

Doctoral students whose MA in political science has been certified, and doctoral students with an MA in political science from Case Western Reserve, need complete only 18 of the 45 hours of doctoral coursework. The graduate studies director will set distribution requirements on an individual basis, reflecting the coursework completed for the MA. Doctoral students without a completed MA must pass the MA examination. They must take the examination upon completion of no fewer than 30 hours and no more than 36 hours of coursework. A student who does not pass this examination may not continue in the PhD program. See the description of the MA examination above for further information.

Upon completion of 45 hours of coursework, the student must pass the PhD comprehensive examinations in his or her primary and secondary subfields. After passing the examinations, a student must complete a dissertation, typically 150-400 pages in length, that draws on the student's original research to make a contribution to the field of political science.

**Dual JD/MA**

Students accepted to the School of Law may pursue a Master of Arts in Political Science in conjunction with their JD degree. Completion of the program requires 97 hours of coursework, and so would be expected to require seven semesters. Students wishing to enroll in the dual-degree program must be separately admitted to each program, but the department will waive the GRE requirement and accept the LSAT in the admissions process.

Students must complete a total of 21 hours of credit within the political science department, including at least three credit hours in American politics, comparative politics, international relations, and research methods. Dual-degree students will normally begin study in the law school and defer enrollment in the MA program until their second year. They must pass the MA comprehensive examination upon completion of their political science coursework.
Department Faculty

Karen Beckwith, PhD
(Syracuse University)
*Flora Stone Mather Professor and Chair*
Politics of gender; mass political participation; comparative political movements; democracy and representation

Justin Buchler, PhD
(University of California, Berkeley)
*Associate Professor*
Congress; redistricting; political strategy; parties and elections

Kathryn C. Lavelle, PhD
(Northwestern University)
*Ellen and Dixon Long Professor in World Affairs*
International relations; international organizations; Congress in world politics; politics of stock markets; governing institutions of national and international finance; U.S. foreign economic policy; Congress and banking policy

Kelly M. McMann, PhD
(University of Michigan)
*Professor; Director, International Studies Program*
Comparative politics; Central Asia; Russia and former East Bloc; democratization

Peter W. Moore, PhD
(McGill University)
*M. A. Hanna Professor of Political Science; Associate Professor*
Comparative politics and political economy of the Middle East and Africa

Elliot Posner, PhD
(University of California, Berkeley)
*Associate Professor*
International relations; international and comparative political economy; politics of finance; international organizations; European Union

Laura Y. Tartakoff, JD, MA
(Case Western Reserve University School of Law; Tufts University)
*Senior Instructor*
Constitutional law; civil liberties; comparative constitutionalism

Joseph White, PhD
(University of California, Berkeley)
*Luxenberg Family Professor of Public Policy; Director, Center for Policy Studies and Public Policy Program; Professor, Department of Epidemiology and Biostatistics, School of Medicine*
American government; Congress; public policy; health and welfare policy; comparative politics of rich democracies

Secondary Faculty

Juscelino Colares, JD, PhD
(Cornell Law School)
*Professor, School of Law*
International law; civil procedure

Adjunct Faculty

Lev Gonick, PhD
(York University, Toronto)
*Adjunct Professor*
Comparative historical international political economy; technology and government

Karl Kaltenthaler, PhD
(Washington University)
*Adjunct Assistant Professor*
Comparative politics, political behavior/public opinion, political extremism and violence, political economy, Europe

Andrew M. Lucker, PhD
(Case Western Reserve University)
*Adjunct Assistant Professor*
American government; state politics and government; history of political science

Michael Wager, JD
(New York University)
*Adjunct Assistant Professor*

Courses

**POSC 109. The U.S. Political System. 3 Units.**
This course provides an overview of governmental institutions and processes in the United States, the political forces that combine to shape them, and how we might best understand the system that government and politics create.

**POSC 160. Introduction to Comparative Politics. 3 Units.**
Comparative politics is the study of processes and institutions within countries. Prompted by real-world puzzles, comparativists investigate broad, theoretical questions such as: What constitutes a revolution, and why do revolutions occur? How does one country become more democratic than another? Why do relations between some ethnic groups turn violent? This course introduces students to some of the central puzzles and theories of comparative politics in order to help them better understand world events. Counts for CAS Global & Cultural Diversity Requirement.

**POSC 172. Introduction to International Relations. 3 Units.**
Why do countries fight wars? Can nuclear proliferation be curtailed? Does trade help developing countries or harm them? This survey of the field of International Relations examines "big questions" in world politics. It introduces themes including the rise, development and changes of the nation-state system; patterns and causes of international conflict and cooperation; international law, organizations, and transnational institutions; the roles of both state and non-state actors in international politics; and the methods used to understand this field.
POSC 301. Decision-Making in American Cities. 3 Units.
Localities are the primary interface with government and provide the basic psychological place identification for most Americans. The course will explore this assertion in the context of urban America today. How are decisions made in cities? Who shapes these decisions and why? What role is played by shifting demographics, race, and poverty? What can the individual do to influence local decision-making? Offered as POSC 301 and POSC 401.

POSC 302. State Politics and Policy. 3 Units.
State governments may make more decisions that affect the life of an average citizen than does the federal government. The study of state politics and policy includes the different ways states organize the basic parts of American political systems (such as legislatures, executives, courts and parties); how state cultures, economies, and other factors shape how political institutions work; institutions of state governance that do not exist at the national level (such as the initiative and referendum); and the continual contest between state and federal governments to control policy, shift costs, and avoid blame. Offered as POSC 302 and POSC 402.

POSC 306. Interest Groups in the Policy Process. 3 Units.
Introduction to the institutions and processes that make up the political environment of nonprofit and other organizations in the United States, beginning with an examination of the role of civil society in a democracy and continuing with the framing of issues, role of political entrepreneurs and organized interests, elections, the legislative process and strategies for influencing it, and the roles of executive institutions and the courts. Offered as POSC 306 and POSC 406.

POSC 308. The American Presidency. 3 Units.
The sources of, strategies of, and restraints on presidential leadership in the United States. Emphasis on problems of policy formation, presidential relations with Congress and executive agencies, and the electoral process. Offered as POSC 308 and POSC 408.

POSC 310. Congress in an Era of Polarization. 3 Units.
A study of Congress in the modern era with emphasis on the development of polarization, procedural changes, conflict between the legislative and executive branches during divided government, and the current state of representation. Offered as POSC 310 and POSC 410.

POSC 319. Politics and Money. 3 Units.
One of the most famous definitions of politics comes from Harold Laswell, who described it as the struggle over “who gets what, when, how.” Money is at the center of most political conflict. It is a resource, a motivation, and an end unto itself. This course will examine the role of money in politics, with particular emphasis on American politics. We will discuss the role of money in elections, in the policy-making process, and what it means for representation. The course will begin with the question of the role that financial consideration play in public opinion and voting behavior. We will then address the role that money plays in election results, both in terms of its role in financing campaigns, and the relationship between the state of the economy and election results. Finally, we will discuss the policy-making process. In that context, we will address the role that interest groups play in the process, and how the quest for economic benefits for one’s constituency motivates the behavior of elected officials. We will conclude by discussing how policy changes at the systematic level occur and the influence that various groups have on policy outcomes. Offered as POSC 319 and POSC 419.

POSC 321. News Media and Politics. 3 Units.
Analysis of the political role of the news media in American government and politics. Examines the fascinating relationship between reporters and politicians. Covers the overall structure and legal position of the media as well as the media’s impact on the American political system. Offered as POSC 321 and POSC 421.

POSC 322. Political Movements and Political Participation. 3 Units.
Political Movements and Political Participation is concerned with the variety of ways citizens engage in collective activism in the United States and across national boundaries, and with the conditions under which citizens identify common concerns and join together in political movements to bring about change. The course begins with an examination of three general bodies of theory and research on political movements: resource mobilization, political opportunity structures, and cultural framing. We will also investigate frameworks of political participation for understanding the relationships among different expressions of collective activism and representation. In the context of these sometimes competing theories, we will consider 1) the conditions under which political movements are likely to emerge, as well as the circumstances in which collective political action is precluded; 2) how citizens come to recognize collective grievances and shared political identities; 3) the strategies and tactics of organized movements, and their likelihood of political success; and 4) the relationship between political movements, political parties, and the state. Offered as POSC 322 and POSC 422.

POSC 323. Judicial Politics. 3 Units.
Rejecting the view that judges mechanically apply the law, the study of judicial politics seeks to understand the behavior of judges as political actors with policy goals. Topics include judicial selection and socialization, judicial policy change, judicial strategy (especially the strategic interaction of judges on multi-judge panels), the interaction of courts in hierarchical judicial systems, the policy impact of judicial decisions, and the courts’ interactions with coordinate branches of government (the executive, Congress, state governments, state courts). Primary focus will be on the federal judiciary, with some discussion of state judicial systems. Offered as POSC 323 and POSC 423.

POSC 325. American Constitutional Law. 3 Units.
An introductory survey of U.S. constitutional law. Special attention given to the historical, philosophical, and political dimensions of landmark Supreme Court cases. Judicial review, federalism, separation of powers, due process, and equal protection. Supreme Court’s involvement in major political controversies: the New Deal, abortion, physician-assisted suicide, school desegregation, and affirmative action. Offered as POSC 325 and POSC 425.

POSC 326. Constitutions in Practical Politics. 3 Units.
Overview of ancient Greek and Roman constitution-making, medieval principles, emergence of modern constitutionalism, and the constitutionalist vision of the American and French Revolutions. Examination of contemporary constitutional issues and developments in countries such as Canada, France, Germany, Great Britain, Ethiopia, India, and the United States. Offered as POSC 326 and POSC 426. Counts for CAS Global & Cultural Diversity Requirement.
POSC 327. Civil Liberties in America. 3 Units.
Supreme Court's interpretation of the First Amendment: liberty of religion through the establishment and free exercise clauses, freedoms of speech and the press, of assembly and association. The "pure tolerance" view examined against subversive speech, "fighting words," libel, and obscenity. Survey of content-neutral regulation, symbolic expression, and current efforts to limit expression (campus speech codes and the feminist anti-pornography movement). Offered as POSC 327 and POSC 427.

POSC 328. Topics in Civil Liberties. 3 Units.
Rights of the accused as outlined in the Fourth, Fifth, Sixth, and Eighth Amendments. Topics covered are (1) arrests, searches, and seizures, (2) the privilege against compelled self-incrimination, (3) the rights to counsel, confrontation, and jury trial, and (4) the prohibition against cruel and unusual punishments. Case-specific approach but presents interplay of history, philosophy, and politics as background of each topic. Offered as POSC 328 and POSC 428.

POSC 334. Violence and the Political System. 3 Units.
Empirical analysis of various theories advanced in the cross-cultural explanation of factors which cause and mediate the occurrence of violence—revolutions, terrorism, and civil disorder—within the political system. Offered as POSC 334 and POSC 434.

POSC 341. Elections, Voters, and Political Parties. 3 Units.
Examination of American political parties, their activities, organization, characteristics, and functions. Candidate strategies and electoral history viewed within the context of voter orientations and predispositions, stressing linkages between citizen and party and between party and government. Offered as POSC 341 and POSC 441.

POSC 342. Water. 3 Units.
This seminar will explore the history of the meaning of water—that is, the social, cultural, and/or political significance placed on water by individuals and governments in different times and places. It will also examine how humans have acted upon water, and how it has acted upon humans, with great consequences for human life. This seminar will look at the history of water in the context of science, technology and society; public health; political science; and environmental history. Case studies will be drawn from a wide chronological and geographical range; from the ancient world to Renaissance Italy, nineteenth century India, modern Britain, Egypt, and the U.S. The course provides a wide perspective on the themes of the history of human-water interactions, but will also focus closely on some critical cases. Seminar participants will write a research paper on the topic of their choice in the environmental history of water. Offered as: HSTY 342, HSTY 442, POSC 342 and POSC 442. Counts for CAS Global & Cultural Diversity Requirement.

POSC 343. Public Opinion and American Democracy. 3 Units.
Examination of theories, concepts and empirical research related to attitudes and the political behavior of mass publics. Offered as POSC 343 and POSC 443.

POSC 346. Women and Politics. 3 Units.
Women and Politics involves a critical examination of the impact of gender on the forms and distributions of power and politics, with primary reference to the experience of women in the United States. Major concerns of the course include what we mean by "sex," "gender," and "politics"; the relationship between women and the state; how women organize collectively to influence state policies; and how the state facilitates and constrains women's access to and exercise of political power. The course is organized around four foci central to the study of women and politics. The first section of the course focuses on what we mean by "women," "gender," and "politics." In this section, we will consider how these concepts intersect and the ways in which each may be used to deepen our understanding of the workings of governments and political systems, and of women's relative political powerlessness. The second section of the course employs these concepts to understand the (re) emergence of the US feminist movement, its meanings, practices, and goals, and its transformation across US political history. In the third section, we turn to conventional electoral politics, focusing on women's candidacies, their campaigns, and women's voting behavior. In the final section of the course, we consider those general factors that might provide for increased gender equality and improved life status for women, in global, comparative perspective. Offered as POSC 346, POSC 446 and WGST 346. Counts as SAGES Departmental Seminar.

POSC 348. History of Modern Political and Social Thought. 3 Units.
This course explores the responses of philosophers, economic theorists, culture critics, and public policy makers to changes in western society wrought by industrialization by focusing on their concerns with technological change. Offered as HSTY 348, HSTY 448 and POSC 348.

POSC 349. Political Science Research Methods. 3 Units.
This course examines approaches that political scientists use to understand events and processes. In doing so, the course provides students with skills helpful to completing senior projects, such as the ability to evaluate and conduct research. Through exercises and projects, students will take part in the research process from constructing a question to developing a research design to interpreting results. Students will learn and apply key techniques, including inductive and deductive reasoning, hypothesis construction, operationalization of concepts, measurements, sampling and probability, causal inference, and the logic of controls. They will produce materials common to the discipline, such as research designs. Offered as POSC 349 and POSC 449. Counts as SAGES Departmental Seminar.

POSC 351. Modern Political Thought. 3 Units.
Examination of a limited topic in the study of modern political thought. Topics vary. Offered as POSC 351 and POSC 451.

POSC 352. American Political Thought. 3 Units.
Examination of the unique contribution to the science of government made by American political thinkers. Offered as POSC 352 and POSC 452.
POSC 353. Political Thought and Political Change in China. 3 Units.
“No state is forever strong or forever weak,” said Han Feizi, China’s great legalist philosopher. He believed that as a country’s conditions changed, the laws and institutions had to change to meet these new circumstances. China today faces new circumstances that have caused deep and broad challenges to its people. This has prompted serious debate among intellectuals, leaders, and average citizens about the possibility for and direction of political reform. But what might that reform look like, and how would it be conceived, if it could overcome the current barriers? This seminar will provide a fuller understanding of China's potential for political change by examining Chinese political thought from Confucius, Mencius and Han Feizi through Mao Zedong and Deng Xiaoping. These and other political philosophies have influenced China’s political culture, which will influence the form of any change. Offered as POSC 353 and POSC 453.

POSC 354. Political and Social Philosophy. 3 Units.
Justification of social institutions, primarily political ones. Such distinctions as that between de facto and legitimate authority; analysis of criteria for evaluation, such as social justice and equality; inquiry into theories of justification of the state; theory of democratic government and its alternatives. Readings from classical and contemporary sources. Recommended preparation: PHIL 101. Offered as PHIL 334, POSC 354, PHIL 434, and POSC 454.

POSC 355. Modern Political Ideologies. 3 Units.
Substance and nature of ideological thinking in the contemporary world via a survey of political “isms”—for example, liberalism, libertarianism, conservatism, fascism, socialism, and even more recent trends such as feminism, environmentalism, etc. Offered as POSC 355 and POSC 455.

POSC 356. Transitions to Democracy and Dictatorship. 3 Units.
Everyday life is dramatically different depending on whether one resides in a democracy or under a dictatorship. This course examines why some countries have democracies and others dictatorships. It explores successful, incomplete, and failed transitions to democracy. The incomplete transitions result in hybrid regimes, stuck between democracy and dictatorship, and the outright failures result in non-democracies, such as dictatorships. The course examines examples from most regions of the world, including Africa, Asia, Europe, the Middle East, the former Soviet Union, North America, and South America. Offered as POSC 356 and POSC 456. Counts for CAS Global & Cultural Diversity Requirement.

POSC 357. Democratic Politics: Theory and Practice. 3 Units.
Study of the theory and application of democracy. The concept of democracy will be examined from the Athenian model to contemporary debates over participatory and deliberative models. Then the concept will be applied to understanding issues of democratic practice and the study of politics in American, comparative, and international arenas. Finally, the course will address the potential effects, both good and ill, of technological innovation on democratic practices, such as “distance” participation, the Internet, and other communication technology. Offered as POSC 357 and POSC 457.

POSC 358. Political Strategy. 3 Units.
This course examines practical applications of prominent political science theories. It is partly a how-to course covering a broad range of political activities, but the primary objective is to link practical issues with theories to help you understand why events happen the way they do. The course focuses on American politics, but the materials will be applicable to a wide range of situations. The course is a seminar requiring regular student presentations that will generate discussion about the readings and current events. Papers consist of analysis of current events, and require students to analyze the strategies used by prominent figures in the context of the theories we discuss in class. Offered as POSC 358 and POSC 458. Counts as SAGES Departmental Seminar.

POSC 360. Revolts and Revolutions in Global Perspective. 3 Units.
The Arab protests of 2011 gripped the attention of the world. Young protestors succeeded in unseating some long time rulers but in other cases tense standoffs have evolved. This course takes those events as a starting point to examine the broader political history of revolts and revolutions in the global south. The first part of the course examines some of the classic social science debates about what constitutes revolution, what leads to revolution, and what the effects can be. The second part of the course analyzes specific cases in Europe, Latin America, Africa, and Asia to understand the causes and consequences of revolt and revolution. What drives everyday persons to brave the dangers of protest? When and why do political leaders decide to resist or reform? What happens when revolts fail? What happens when they succeed? Material for the course will include classic social science narratives, revolutionary polemics, popular analyses of events since 2011, examples of social media as political action, and first person narratives. Offered as POSC 360 and POSC 460. Counts for CAS Global & Cultural Diversity Requirement.

POSC 361. State-Building and State Collapse. 3 Units.
Are nation-states the most effective means of organizing society? This course explores this question by examining the historical rationales behind the development of the nation-state, contemporary challenges to the nation-state, and potential alternatives to the nation-state. Possible challenges to the nation-state include multinational corporations, international humanitarian intervention, and regional integration. Alternative providers of state services include charities, companies, and mercenaries. Offered as POSC 361 and POSC 461. Counts for CAS Global & Cultural Diversity Requirement.

POSC 362. Politics of Central Asia. 3 Units.
Once an unfamiliar region to many people of the world, Central Asia took center stage in the fall of 2001 as a result of the U.S. campaign against terrorism. This course will introduce students to the politics of Central Asia, focusing on the region today composed of Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, and Kazakhstan. We will review the nationalism, foreign relations, religion, ethnicity, and economics of the region. Offered as ETHS 362, POSC 362, and POSC 462. Counts for CAS Global & Cultural Diversity Requirement.
POSC 363. Comparative Analysis of Elections and Electoral Systems. 3 Units.
Elections involve more than a simple act of voting to express individual preferences. The rules under which worldwide elections are held determine who controls the executive and how votes are converted into legislative seats. The mechanics of various electoral arrangements will be examined in detail and the consequences for the political system discussed in terms of strategies and desired outcomes on the part of contestants. Students will research individual countries and analyze recent elections from both qualitative and quantitative perspectives, including introduction to geospatial data for mapping variations in electoral behavior. Offered as POSC 363 and POSC 463. Counts as SAGES Departmental Seminar.

POSC 364. Dictatorship and Democracy in Modern Latin America. 3 Units.
Examination of political leadership in 20th-century Latin America, exploring the nature, causes, and consequences of dictatorship and democracy in the region, moving from the collapse of oligarchic rule and the emergence of populism in the 1930s and 1940s, to the end of democracy and establishment of military regimes in the 1960s and 1970s, and ultimately to the contemporary processes of democratization and economic liberalization. Offered as ETHS 364, POSC 364, and POSC 464. Counts for CAS Global & Cultural Diversity Requirement.

POSC 365. Science, Technology, and Government. 3 Units.
Traces the development and influence of federal technology and science policies from colonial times to the present, with emphasis on the 20th century. Offered as HSTY 366 and POSC 365.

POSC 366. Government and Politics of Africa. 3 Units.
Comparative analysis of the political forces and organizations currently functioning in Africa, as well as a survey of the formal government institutions. Special emphasis on single-party rule, military rule, and the political ramifications of African socialism, tribalism and the problems of national integration. Offered as ETHS 366, POSC 366, and POSC 466.

POSC 367. Western European Political Systems. 3 Units.
Comparative analysis of sociopolitical systems of selected Western European industrial democracies, using North American systems as a point of comparison. Offered as POSC 367 and POSC 467.

POSC 369. Ethnicity, Gender, and Religion in Latin American Politics and Society. 3 Units.
This course focuses on aspects of Latin America's social and political realities and dilemmas. It will first explore race, gender, and religion, and then tackle revolution, democracy and populism. Throughout, the entire region's history, geography, and culture(s) will be considered; for example, the European and indigenous legacies in Mexico and Peru, Bolivia, Chile, and Ecuador; the Asian presence in Peru and Brazil; the African contributions to Cuba and Brazil, female heads of state, such as Nicaragua's Violeta Chamorro, Chile's Michelle Bachelet, Argentina's Cristina Fernandez de Kirchner, Costa Rica's Laura Chinchilla, and Brazil's Dilma Rousseff. The class will explore Liberation Theology and the new Pope's worries about the declining number of Catholics in the region. Today's multiparty democracy in Mexico, Hugo Chavez's 14-year rule in Venezuela, and Cuba's international humanitarian aid would not be possible without revolution(s) and populism. They are intertwined with ethnicity, gender, and religion. Offered as ETHS 369, POSC 369 and POSC 469. Counts for CAS Global & Cultural Diversity Requirement.

POSC 370A. Political Economy. 3 Units.
Focus on debates concerning the proper relationship between political and economic systems, including conservative, liberal, and radical perspectives. The politics of international economics and the economics of international politics receive separate attention. The course concludes with study of "modern" political economy and the application of economic theory to the study of political systems. Offered as POSC 370A and POSC 470A.

POSC 370C. The United States and Asia. 3 Units.
Survey and analysis of U.S.-Asia relations in the post-World War II period. Focus specifically is on the interaction of politics and economics in the United States' relations with Japan, China, and Southeast Asian countries. Topics will include the role of Asia in U.S. Cold War policies, the dynamics of U.S.-Japan alliance politics, post-Cold War issues involving U.S. foreign policy toward Asia, a history and analysis of economic conflict cooperation, and an examination of the move toward Asia-Pacific "regionalism." Offered as POSC 370C and POSC 470C.

POSC 370D. The Politics of China. 3 Units.
Now more than ever, the Chinese state and society are facing tremendous economic, social, and political challenges. This course presents an overview of current issues facing the People's Republic, including a changing (or not) political culture, policy processes and outcomes at the national and local levels, reform and economic growth, the resultant societal changes and pressures, and the consequent challenges the Communist Party faces as demand for political reform grows. The class involves a mixture of lectures and discussion and draws on a combination of primary and secondary sources, including current news reports and films. Offered as POSC 370D and POSC 470D. Counts for CAS Global & Cultural Diversity Requirement.

POSC 370F. Financial Politics in the United States and the World. 3 Units.
This course explores how political institutions make policy in the financial area with particular emphasis on the United States. Using a bureaucratic politics framework, it examines money, banks and the securities industry by integrating a wide range of literature in economics and political science. Specific objectives include familiarizing students with different approaches to the political economy of finance from different disciplines, exploring the historical evolution of finance, examining the changing relationship between public and private authority within the financial system, considering how politics operates in a crisis, and evaluating the role of international financial institutions in the global economy. By taking this course, students will equip themselves for further research into politics and economics, as well as offer them tools to analyze future policy developments as they unfold. Offered as POSC 370F and POSC 470F.

POSC 370G. U.S. Intelligence and National Security. 3 Units.
Examination of the impact of the intelligence process on foreign policy making and superpower relations. Covers the life cycle of United States strategic intelligence from the collection of data to formulation of analytic judgments and the policy-level uses of intelligence. Emphasis on contemporary intelligence issues and processes, but includes the formative period of modern American intelligence in the World War II era. Offered as POSC 370G and POSC 470G.
POSC 370H. China's Foreign Policy. 3 Units.
The rise of China is evident in the country's more forward and robust foreign policy that began in 1979. At every turn, nations throughout the world must now consider China wherever their interests are at stake, be it Korea and Northeast Asia, Indochina and Southeast Asia, India/Pakistan and South Asia, or Afghanistan and Iran in the Middle East, not to mention the many African states that welcome Chinese investment but chafe at China's presence. Further, China is increasingly aggressive in international trade, a major determinant of its foreign policy. This course describes the key factors that make up Chinese foreign policy, including its cultural tradition, policy-making institutions, the role of the military, and domestic determinants of foreign policy. The course also examines China's ever-changing foreign policy strategies, from an aggressive posture to charming its neighbors only to become more strident once again. The course will also examine China's role involving possible mercantilism, currency manipulation, and the hunt for traditional and alternative energy sources. Throughout the course, we will pay attention to how China's foreign policy relates to international relations theories and what strategies might be used to manage China's growing role in international affairs. Offered as POSC 370H and POSC 470H. Counts for CAS Global & Cultural Diversity Requirement.

POSC 370J. International Law and Organizations. 3 Units.
Study of international organizations and international law as two means for regulating and coordinating nation-state behavior. History of the two techniques will be traced, covering 19th century efforts at cooperation, the League of Nations and the United Nations, regional and specialized global organization. The functions of international law in global politics will be stressed, with primary focus on the evolving role of law in dealing with global problems, e.g., war, the environment, economic cooperation, and human rights. Offered as POSC 370J and POSC 470J.

POSC 370K. Nationalism, Ethnicity, and Religion in World Politics. 3 Units.
Examination of the post-Cold War surge in conflicts among nationalism, ethnic groups, and religions with particular attention to the former Yugoslavia, Ireland, India, Africa, and the Middle East. Offered as ETHS 370K, POSC 370K, and POSC 470K.

POSC 370M. Theories of Political Economy. 3 Units.
This course is a SAGES departmental seminar in political economy that brings a wide range of theoretical perspectives to bear on the relations between market and state in the contemporary world. It focuses on three questions: What have been the major debates concerning the role of the government in the economy? How were these debates resolved in the compromise of embedded liberalism, and What experiences have individual states had with these questions of political economy? To answer these questions, we will read original literature to uncover the connections among politics, economics, and the world of ideas that has resulted in the political debates we confront today. Offered as POSC 370M and POSC 470M. Counts as SAGES Departmental Seminar.

POSC 371. Natural Resources and World Politics. 3 Units.
Examination of the political causes and ramifications of the uneven distribution of the valuable natural resources for modern industrial societies. Strategic and military issues and the exploitation of the sea bed. Examination in some detail of selected commodity issues, including petroleum, copper and uranium. Offered as POSC 371 and POSC 471.

POSC 372. Activism Beyond Borders: NGOs and International Advocacy. 3 Units.
This course examines the role of non-state actors, and particularly non-governmental organizations (NGOs) in world politics. We will begin with a survey of traditional theoretical approaches to international relations, so that students can be conversant in the basic theory and vocabulary of the discipline. We then examine the growing role of NGOs in world politics amidst the broader trend of globalization, and the academic and policy debates surrounding each. After this primer, the course will examine four "big questions" with respect to international activism: 1) When do NGOs mobilize? 2) What tactics do they use? 3) What explains success and failure in advocacy? 4) What are the broader political implications of a global class of elite advocates? Offered as POSC 372 and POSC 472.

POSC 373. Politics of the European Union. 3 Units.
Study of the origins, operations, and prospects for the European Union. This can include the historical context for the effort to restrict national rivalries (which fueled two world wars) and create common interests; the diplomatic challenges in finding common ground; the tasks and processes of governance within the EU, including its governing institutions, enforcement of terms for European Monetary Union and the operations of its bureaucracies; the social pressures that create policy challenges (such as agriculture policy and immigration); broad tensions within the enterprise (e.g., "broadening" vs. "deepening"), and the EU's potential place in international politics, especially the efforts to create a common foreign and security policy and the possible implications of the Euro for international political economy. Offered as POSC 373 and POSC 473.

POSC 374. Politics of Development in the Global South. 3 Units.
Exploration of the post-World War II emergence of the Global South nations of Africa, Asia, the Middle East, Latin America, and the Eastern Europe arena. Offered as ETHS 374, POSC 374, and POSC 474.

POSC 375. The International Politics of Technology. 3 Units.
Technology is deeply political. Nowadays is this statement more evident than in the realm of international relations, where governments perceive technology as a source of power and wealth and a symbol of relative position and modernity. Yet for centuries skeptics have questioned the economic rationale of government technology policies. Still, to this day, countries support emulation, innovation and a host of other strategies as means for catching up with leading nations or locking in current advantages. What lies behind such policies? What do they accomplish? And what are the domestic and international politics surrounding them? After reading classic arguments, including texts by Adam Smith, Alexander Hamilton and Friedrich List, students will consider 20th and 21st century debates and an array of experiments tried by poor, middle-income and rich countries. Cases include the development of new industries; the imposition of sanctions; the dilemma of dual technologies and military spillovers; the forging of national champions; the reorganization of banks and the creation of international financial centers; the copying of regional clusters (e.g. Silicon Valley) and stock markets (e.g. the Nasdaq); and the extraterritorial extension of domestic regulation and governance techniques. There are no prerequisites and first year students are welcome. Offered as POSC 375 and POSC 475. Counts as SAGES Departmental Seminar.

POSC 376. United States Foreign Policy. 3 Units.
Focus on U.S. foreign policy making with a dynamic network of executive and congressional actors and organizations; analysis of traditional and contemporary U.S. foreign policies from nuclear defense to current economic resource issues; future role of the United States in world affairs. Offered as POSC 376 and POSC 476.
POSC 377. Politics of Russia. 3 Units.
Russia faces three problems: the creation of a sovereign state, the development of a new political system, and the restructuring of its economy. In this course we will challenge the assumption that the outcome of these three transitions will be a strong, democratic, capitalist country. We will ask whether civil war, organized crime, an immature party system, poor social services, and nomenklatura privatization bode poorly for these three transformations. Offered as POSC 377 and POSC 477. Counts for CAS Global & Cultural Diversity Requirement.

POSC 378. International Relations Theory. 3 Units.
This course is a seminar in international relations theory. As such, we will bring a wide range of theoretical perspectives to bear on issues and debates in the area of international relations by systematically studying the evolution of the world system. The seminar is roughly divided into a first half focusing on war and the political system, and a second half focusing on trade, finance and the economic system. Each section devotes particular attention to ethical problems associated with political and economic issues. This course should develop students’ ability to read and critically evaluate academic literature in the field of international relations, and enable students to produce a scholarly paper on one substantive area of the field. Offered as POSC 378 and POSC 478. Counts as SAGES Departmental Seminar.

POSC 379. Introduction to Middle East Politics. 3 Units.
This is an introductory course about Middle East Politics, in regional as well as international aspects. In this course we will explore broad social, economic, and political themes that have defined the region since the end of World War Two. Since this is an introductory course, a major goal will be to gain comparative knowledge about the region’s states and peoples. The countries that comprise the modern Middle East are quite diverse; therefore, we will only be able to focus on a few cases in depth. A second goal is to use the tools and theories social scientists employ to answer broad questions related to the region, such as: How have colonial legacies shaped political and economic development in the Middle East? How do oil, religion, and identity interact with politics? How have external powers affected the region’s political development? What do the uprisings of 2011 hold for the region’s future? Offered as POSC 379 and POSC 479. Counts for CAS Global & Cultural Diversity Requirement.

POSC 380A. State and War in Africa and the Middle East. 3 Units.
The Middle East, North Africa, and Sub-Saharan Africa remain the most volatile and conflict prone regions of the world. Traditional approaches to war and state conflict have emphasized systemic variables, such as balance of power, military capabilities, perceptions, the security dilemma, and of course anarchy. While these concepts have generated much academic interest, their ability to explain and understand conflict in the developing world is severely limited. This is due to the basic fact that nearly all conflict in the world today is not between states but is taking place within state boundaries. What drives these conflicts? Are there common factors and patterns within the Middle East and Africa? How does sub-state conflict affect political and economic development? What are the most likely resolution strategies? Recommended preparation: POSC 379. Counts as SAGES Departmental Seminar.

POSC 380B. Uprising and Political Change in the Arab World. 3 Units.
This course explores political and social change in the Arab World with an emphasis on the 2011 uprisings. It is designed into a three week format taking place in the Arab World. Since the early 20th century, the 22 countries that comprise the Arab World have experienced multifaceted and rapid change. Coups, revolts, and revolution defined much of the 1950s and 1960s. In the ensuing decades however, Arab politics settled into seemingly stable political authoritarianism. Thus, it was a surprise when mobilized protesters unseated some leaders in 2011. The primary questions for scholars and students is, what explains these momentous events? And what happens after? This course will take up these questions by carefully examining political and social change in the decades before 2011. By holding the course in an Arab country, students will be able to place the broad themes within a local context. Investigation and lectures will explore not just the history of change and protest but why protest succeeded in removing leaders in some countries yet was defeated in others. The ultimate goal is for students to gain the skills to pursue these questions at a macro-scholarly level as well as unpack those same questions at a local and regional level. Guest lectures and field trips are designed as far more than just visits. Each event will require students to inquire, converse, and research local conditions to address the larger questions. Primary course requirements include a daily journal, a short exam, and a final paper. Counts for CAS Global & Cultural Diversity Requirement.

POSC 381. City as Classroom. 3 Units.
In this course, the city is the classroom. We will engage with the urban terrain. We will meet weekly off-campus, interact with community members, and interface—both literally and figuratively—with the city as a way to examine the linkages between historical, conceptual, and contemporary issues, with particular attention paid to race and class dynamics, inequality, and social justice. This course will have four intersecting components, primarily focusing on American cities since the 1930s: the social and physical construction of urban space, the built environment, life and culture in the city, and social movements and grassroots struggles. Offered as HSTY 381, POSC 381, SOCI 381, HSTY 481, POSC 481, and SOCI 481. Counts for CAS Global & Cultural Diversity Requirement.

POSC 382A. Child Policy. 3 Units.
This course introduces students to issues in public policy that impact children and families. Local, state, and federal child policy will be considered, and topics will include, for example, policies related to child poverty, education, child welfare, juvenile justice, and children’s physical and mental health. Students will learn how policy is developed, how research informs policy and vice versa, and a framework for analyzing social policy. Recommended preparation: One social sciences course or consent. Offered as ANTH 305, CHST 301, and POSC 382A.

POSC 383. Health Policy and Politics in the United States. 3 Units.
Overview of the principal institutions, processes, social forces, and ideas shaping the U.S. health system. Historical, political, economic, and sociological perspectives on the health system are explored as well as the intellectual context of recent policy changes, challenges, and developments. Students will acquire a sense of how health services are financed and delivered in the U.S. They will also learn how to assess its performance compared to that of other similar countries. Offered as POSC 383 and POSC 483.
POSC 384. Ethics and Public Policy. 3 Units.
Evaluation of ethical arguments in contemporary public policymaking discourse. That is, approaches to evaluating not only the efficiency of policy (Will this policy achieve its end for the least cost?) but also the ethics of policy (Are a policy’s intended ends ethically justified or “good,” and are our means to achieve those ends moral or “just”?). Overview of political ideologies that supply U.S. political actors with their ethical or moral arguments when proposing and implementing public policy, followed by an application of these differing perspectives to selected policy areas such as welfare, euthanasia, school choice, drug laws, censorship, or others. Offered as PHIL 384, PHIL 484, POSC 384 and POSC 484.

POSC 385. U.S. Bureaucratic Politics. 3 Units.
Bureaucracy is one of civilization’s most important inventions. It is a way of coordinating very large numbers of people so as to do work, make decisions, and exercise power. Without it, much of modern life would be impossible. Yet “bureaucracy” is normally seen, in public discussion, as a problem, instead of as a solution. This course will consider both the reasons for and pathologies of bureaucratic organization. Its special focus is bureaucracy in American government. The course therefore will provide some introduction to the study of American public administration, but with special emphasis on how the work and performance of public bureaucracies in the United States is shaped by the specific tasks they are given and the distribution of power in the American political arena. Offered as POSC 385 and POSC 485. Counts as SAGES Departmental Seminar.

POSC 386. Making Public Policy. 3 Units.
Politics is about who wins, who loses, and why. Policy, by contrast, is often depicted as more “neutral;” policies are the means through which political decisions are carried out. In this class, we examine the notion that policy is the rational, impartial counterpart to the political arena. We will ask: How are public policies made? Why do some issues make it on to the agenda, while others do not? Can we separate facts from values, or are both always contested? We will examine how decision-making in a group introduces distinct challenges for policymaking. The course focuses on widely applicable themes of policymaking, drawing on both domestic and international examples. Offered as POSC 386 and POSC 486.

POSC 388. Politics, Policy, and the Global Environment. 3 Units.
This course examines the law, politics and policy surrounding global environmental challenges such as climate change. The course aims to provide a broad overview of the key concepts, actors, debates, and issues in global environmental politics. It aims to illustrate the complexities of addressing environmental problems—from the proliferation of global institutions and international actors, to the absence of central enforcement mechanisms. We examine the causes of environmental degradation and competing views on the gravity of the problem. Using concepts from political science and economics, we investigate the challenges in getting states to act jointly to address environmental problems. We examine the actors and institutions of global environmental politics, to understand how conditions are defined as problems and responses are chosen and implemented. The course concludes by applying the tools and concepts to the case of climate change. Offered as ESTD 388, POSC 388 and POSC 488.

POSC 389. Special Topics in American Politics and Policy. 3 Units.
Specific topic will vary but will consist of an in-depth investigation of a particular policy area or political phenomenon. Topics will involve policy controversies of some current interest. Offered as POSC 389 and POSC 489.

POSC 390. Special Topics in International Relations. 3 Units.
This course will vary semester to semester and will focus on International Relations topics such as statecraft and diplomacy in contemporary world affairs; weak states and international sovereignty; and transnational soft law. A description of the topic(s) being covered will be available on the political science website each semester that the course is offered. Students may take this course more than once for up to 9 credits, when different topics are covered. Offered as POSC 390 and POSC 490.

POSC 391. Special Topics in Comparative Politics. 3 Units.
This course will vary semester to semester and will focus on comparative politics topics involving political issues and/or controversies of some current interest. These may include some of the following: federal vs unitary political systems, nationalism and national identity, independence movements in developed countries, comparative political behavior, national and supranational political organization, comparative public policy, political violence and violent conflict, comparative political economy, varieties of democracy, the comparative politics of gender, comparative race and ethnicity, among others. A description of the specific course topic focus will be available on the political science website each semester that the course is offered. Students may take this course more than once (up to 9 credits) so long as the topics are different. Offered as POSC 391 and POSC 491.

POSC 395. Special Projects. 1 - 6 Units.
Study of a topic of particular interest, and/or independent academic work associated with an approved internship. The student must submit to the departmental office a project prospectus form, approved and signed by the faculty supervisor, no later than the end of the second week of classes. The prospectus must outline the goals of the project and the research methodology to be used, and is part of the basis for grading. The prospectus form is available from the departmental office or from the department’s webpage.

POSC 396. Senior Project SAGES Capstone. 3 Units.
Capstone experience for political science majors or senior POSC minors as part of the SAGES program, providing opportunity to do an in-depth paper on a topic of particular interest to them. Students must obtain approval from a faculty project advisor and list that advisor on the registration form. The advisor must sign and student submit to department a prospectus including goals, schedule, and research methodology. This paper should demonstrate, and ideally even extend, the skills and expertise developed over the course of study in the department. Upon completion of the capstone, students will be expected to present their work in a public forum. Recommended preparation: Junior or Senior political science major or senior political science minor and departmental prospectus form. Counts as SAGES Senior Capstone.

POSC 401. Decision-Making in American Cities. 3 Units.
Localities are the primary interface with government and provide the basic psychological place identification for most Americans. The course will explore this assertion in the context of urban America today. How are decisions made in cities? Who shapes these decisions and why? What role is played by shifting demographics, race, and poverty? What can the individual do to influence local decision-making? Offered as POSC 301 and POSC 401.
POSC 402. State Politics and Policy. 3 Units.
State governments may make more decisions that affect the life of an average citizen than does the federal government. The study of state politics and policy includes the different ways states organize the basic parts of American political systems (such as legislatures, executives, courts, and parties); how state cultures, economies, and other factors shape the potential institutions work; institutions of state government that do not exist at the national level (such as the initiative and referendum); and the continual contest between state and federal governments to control policy, shift costs, and avoid blame. Offered as POSC 302 and POSC 402.

POSC 406. Interest Groups in the Policy Process. 3 Units.
Introduction to the institutions and processes that make up the political environment of nonprofit and other organizations in the United States, beginning with an examination of the role of civil society in a democracy and continuing with the framing of issues, role of political entrepreneurs and organized interests, elections, the legislative process and strategies for influencing it, and the roles of executive institutions and the courts. Offered as POSC 306 and POSC 406.

POSC 408. The American Presidency. 3 Units.
The sources of, strategies of, and restraints on presidential leadership in the United States. Emphasis on problems of policy formation, presidential relations with Congress and executive agencies, and the electoral process. Offered as POSC 308 and POSC 408.

POSC 410. Congress in an Era of Polarization. 3 Units.
A study of Congress in the modern era with emphasis on the development of polarization, procedural changes, conflict between the legislative and executive branches during divided government, and the current state of representation. Offered as POSC 310 and POSC 410.

POSC 419. Politics and Money. 3 Units.
One of the most famous definitions of politics comes from Harold Laswell, who described it as the struggle over "who gets what, when, how." Money is at the center of most political conflict. It is a resource, a motivation, and an end unto itself. This course will examine the role of money in politics, with particular emphasis on American politics. We will discuss the role of money in elections, in the policy-making process, and what it means for representation. The course will begin with the question of the role that financial consideration play in public opinion and voting behavior. We will then address the role that money plays in election results, both in terms of its role in financing campaigns, and the relationship between the state of the economy and election results. Finally, we will discuss the policy-making process. In that context, we will address the role that interest groups play in the process, and how the quest for economic benefits for one's constituency motivates the behavior of elected officials. We will conclude by discussing how policy changes at the systematic level occur and the influence that various groups have on policy outcomes. Offered as POSC 319 and POSC 419.

POSC 421. News Media and Politics. 3 Units.
Analysis of the political role of the news media in American government and politics. Examines the fascinating relationship between reporters and politicians. Covers the overall structure and legal position of the media as well as the media's impact on the American political system. Offered as POSC 321 and POSC 421.

POSC 422. Political Movements and Political Participation. 3 Units.
Political Movements and Political Participation is concerned with the variety of ways citizens engage in collective activism in the United States and across national boundaries, and with the conditions under which citizens identify common concerns and join together in political movements to bring about change. The course begins with an examination of three general bodies of theory and research on political movements: resource mobilization, political opportunity structures, and cultural framing. We will also investigate frameworks of political participation for understanding the relationships among different expressions of collective activism and representation. In the context of these sometimes competing theories, we will consider 1) the conditions under which political movements are likely to emerge, as well as the circumstances in which collective political action is precluded; 2) how citizens come to recognize collective grievances and shared political identities; 3) the strategies and tactics of organized movements, and their likelihood of political success; and 4) the relationship between political movements, political parties, and the state. Offered as POSC 322 and POSC 422.

POSC 423. Judicial Politics. 3 Units.
Rejecting the view that judges mechanically apply the law, the study of judicial politics seeks to understand the behavior of judges as political actors with policy goals. Topics include judicial selection and socialization, judicial policy change, judicial strategy (especially the strategic interaction of judges on multi-judge panels), the interaction of courts in hierarchical judicial systems, the policy impact of judicial decisions, and the courts' interactions with coordinate branches of government (the executive, Congress, state governments, state courts). Primary focus will be on the federal judiciary, with some discussion of state judicial systems. Offered as POSC 323 and POSC 423.

POSC 425. American Constitutional Law. 3 Units.
An introductory survey of U.S. constitutional law. Special attention given to the historical, philosophical, and political dimensions of landmark Supreme Court cases. Judicial review, federalism, separation of powers, and protection. Supreme Court's involvement in major political controversies: the New Deal, abortion, physician-assisted suicide, school desegregation, and affirmative action. Offered as POSC 325 and POSC 425.

POSC 426. Constitutions in Practical Politics. 3 Units.
Overview of ancient Greek and Roman constitution-making, medieval principles, emergence of modern constitutionalism, and the constitutionalist vision of the American and French Revolutions. Examination of contemporary constitutional issues and developments in countries such as Canada, France, Germany, Great Britain, Ethiopia, India, and the United States. Offered as POSC 326 and POSC 426. Counts for CAS Global & Cultural Diversity Requirement.

POSC 427. Civil Liberties in America. 3 Units.
Supreme Court's interpretation of the First Amendment: liberty of religion through the establishment and free exercise clauses, freedoms of speech and the press, and assembly and association. The "pure tolerance" view examined against subversive speech, "fighting words," libel, and obscenity. Survey of content-neutral regulation, symbolic expression, and current efforts to limit expression (campus speech codes and the feminist anti-pornography movement). Offered as POSC 327 and POSC 427.
POSC 428. Topics in Civil Liberties. 3 Units.
Rights of the accused as outlined in the Fourth, Fifth, Sixth, and Eighth Amendments. Topics covered are (1) arrests, searches, and seizures, (2) the privilege against compelled self-incrimination, (3) the rights to counsel, confrontation, and jury trial, and (4) the prohibition against cruel and unusual punishments. Case-specific approach but presents interplay of history, philosophy, and politics as background of each topic. Offered as POSC 328 and POSC 428.

POSC 434. Violence and the Political System. 3 Units.
Empirical analysis of various theories advanced in the cross-cultural explanation of factors which cause and mediate the occurrence of violence—revolutions, terrorism, and civil disorder—within the political system. Offered as POSC 334 and POSC 434.

POSC 441. Elections, Voters, and Political Parties. 3 Units.
Examination of American political parties, their activities, organization, characteristics, and functions. Candidate strategies and electoral history viewed within the context of voter orientations and predispositions, stressing linkages between citizen and party and between party and government. Offered as POSC 341 and POSC 441.

POSC 442. Water. 3 Units.
This seminar will explore the history of the meaning of water—that is, the social, cultural, and/or political significance placed on water by individuals and governments in different times and places. It will also examine how humans have acted upon water, and how it has acted upon humans, with great consequences for human life. This seminar will look at the history of water in the context of science, technology and society; public health; political science; and environmental history. Case studies will be drawn from a wide chronological and geographical range; from the ancient world to Renaissance Italy, nineteenth century India, modern Britain, Egypt, and the U.S. The course provides a wide perspective on the themes of the history of human-water interactions, but will also focus closely on some critical cases. Seminar participants will write a research paper on the topic of their choice in the environmental history of water. Offered as: HSTY 342, HSTY 442, POSC 342 and POSC 442. Counts for CAS Global & Cultural Diversity Requirement.

POSC 443. Public Opinion and American Democracy. 3 Units.
Examination of theories, concepts and empirical research related to attitudes and the political behavior of mass publics. Offered as POSC 343 and POSC 443.

POSC 446. Women and Politics. 3 Units.
Women and Politics involves a critical examination of the impact of gender on the forms and distributions of power and politics, with primary reference to the experience of women in the United States. Major concerns of the course include what we mean by "sex," "gender," and "politics," the relationship between women and the state; how women organize collectively to influence state policies; and how the state facilitates and constrains women's access to and exercise of political power. The course is organized around four foci central to the study of women and politics. The first section of the course focuses on what we mean by "women," "gender," and "politics." In this section, we will consider how these concepts intersect and the ways in which each may be used to deepen our understanding of the workings of governments and political systems, and of women's relative political powerlessness. The second section of the course employs these concepts to understand the (re) emergence of the US feminist movement, its meanings, practices, and goals, and its transformation across US political history. In the third section, we turn to conventional electoral politics, focusing on women's candidacies, their campaigns, and women's voting behavior. In the final section of the course, we consider those general factors that might provide for increased gender equality and improved life status for women, in global, comparative perspective. Offered as POSC 346, POSC 446 and WGST 346. Counts as SAGES Departmental Seminar.

POSC 449. Political Science Research Methods. 3 Units.
This course examines approaches that political scientists use to understand events and processes. In doing so, the course provides students with skills helpful to completing senior projects, such as the ability to evaluate and conduct research. Through exercises and projects, students will take part in the research process from constructing a question to developing a research design to interpreting results. Students will learn and apply key techniques, including inductive and deductive reasoning, hypothesis construction, operationalization of concepts, measurements, sampling and probability, causal inference, and the logic of controls. They will produce materials common to the discipline, such as research designs. Offered as POSC 349 and POSC 449. Counts as SAGES Departmental Seminar.

POSC 451. Modern Political Thought. 3 Units.
Examination of a limited topic in the study of modern political thought. Topics vary. Offered as POSC 351 and POSC 451.

POSC 452. American Political Thought. 3 Units.
Examination of the unique contribution to the science of government made by American political thinkers. Offered as POSC 352 and POSC 452.

POSC 453. Political Thought and Political Change in China. 3 Units.
"No state is forever strong or forever weak," said Han Feizi, China's great legalist philosopher. He believed that as a country's conditions changed, the laws and institutions had to change to meet these new circumstances. China today faces new circumstances that have caused deep and broad challenges to its people. This has prompted serious debate among intellectuals, leaders, and average citizens about the possibility for and direction of political reform. But what might that reform look like, and how would it be conceived, if it could overcome the current barriers? This seminar will provide a fuller understanding of China's potential for political change by examining Chinese political though from Confucius, Mencius and Han Feizi through Mao Zedong and Deng Xiaoping. These and other political philosophies have influenced China's political culture, which will influence the form of any change. Offered as POSC 353 and POSC 453.
POSC 454. Political and Social Philosophy. 3 Units.
Justification of social institutions, primarily political ones. Such distinctions as that between de facto and legitimate authority; analysis of criteria for evaluation, such as social justice and equality; inquiry into theories of justification of the state; theory of democratic government and its alternatives. Readings from classical and contemporary sources. Recommended preparation: PHIL 101. Offered as PHIL 334, POSC 354, PHIL 434, and POSC 454.

POSC 455. Modern Political Ideologies. 3 Units.
Substance and nature of ideological thinking in the contemporary world via a survey of political "isms"—for example, liberalism, libertarianism, conservatism, fascism, socialism, and even more recent trends such as feminism, environmentalism, etc. Offered as POSC 355 and POSC 455.

POSC 456. Transitions to Democracy and Dictatorship. 3 Units.
Everyday life is dramatically different depending on whether one resides in a democracy or under a dictatorship. This course examines why some countries have democracies and others dictatorships. It explores successful, incomplete, and failed transitions to democracy. The incomplete transitions result in hybrid regimes, stuck between democracy and dictatorship, and the outright failures result in non-democracies, such as dictatorships. The course examines examples from most regions of the world, including Africa, Asia, Europe, the Middle East, the former Soviet Union, North America, and South America. Offered as POSC 356 and POSC 456. Counts for CAS Global & Cultural Diversity Requirement.

POSC 457. Democratic Politics: Theory and Practice. 3 Units.
Study of the theory and application of democracy. The concept of democracy will be examined from the Athenian model to contemporary debates over participatory and deliberative models. Then the concept will be applied to understanding issues of democratic practice and the study of politics in American, comparative, and international arenas. Finally, the course will address the potential effects, both good and ill, of technological innovation on democratic practices, such as "distance" participation, the Internet, and other communication technology. Offered as POSC 357 and POSC 457.

POSC 458. Political Strategy. 3 Units.
This course examines practical applications of prominent political science theories. It is partly a how-to course covering a broad range of political activities, but the primary objective is to link practical issues with theories to help you understand why events happen the way they do. The course focuses on American politics, but the materials will be applicable to a wide range of situations. The course is a seminar requiring regular student presentations that will generate discussion about the readings and current events. Papers consist of analysis of current events, and require students to analyze the strategies used by prominent figures in the context of the theories we discuss in class. Offered as POSC 358 and POSC 458. Counts as SAGES Departmental Seminar.

POSC 460. Revolts and Revolutions in Global Perspective. 3 Units.
The Arab protests of 2011 gripped the attention of the world. Young protestors succeeded in unseating some long time rulers but in other cases tense standoffs have evolved. This course takes those events as a starting point to examine the broader political history of revolts and revolutions in the global south. The first part of the course examines some of the classic social science debates about what constitutes revolution, what leads to revolution, and what the effects can be. The second part of the course analyzes specific cases in Europe, Latin America, Africa, and Asia to understand the causes and consequences of revolt and revolution. What drives everyday persons to brave the dangers of protest? When and why do political leaders decide to resist or reform? What happens when revolts fail? What happens when they succeed? Material for the course will include classic social science narratives, revolutionary polemics, popular analyses of events since 2011, examples of social media as political action, and first person narratives. Offered as POSC 360 and POSC 460. Counts for CAS Global & Cultural Diversity Requirement.

POSC 461. State-Building and State Collapse. 3 Units.
Are nation-states the most effective means of organizing society? This course explores this question by examining the historical rationales behind the development of the nation-state, contemporary challenges to the nation-state, and potential alternatives to the nation-state. Possible challenges to the nation-state include multinational corporations, international humanitarian intervention, and regional integration. Alternative providers of state services include charities, companies, and mercenaries. Offered as POSC 361 and POSC 461. Counts for CAS Global & Cultural Diversity Requirement.

POSC 462. Politics of Central Asia. 3 Units.
Once an unfamiliar region to many people of the world, Central Asia took center stage in the fall of 2001 as a result of the U.S. campaign against terrorism. This course will introduce students to the politics of Central Asia, focusing on the region today composed of Uzbekistan, Turkmenistan, Tajikistan, Kyrgyzstan, and Kazakhstan. We will review the nationalism, foreign relations, religion, ethnicity, and economics of the region. Offered as ETHS 362, POSC 362, and POSC 462. Counts for CAS Global & Cultural Diversity Requirement.

POSC 463. Comparative Analysis of Elections and Electoral Systems. 3 Units.
Elections involve more than a simple act of voting to express individual preferences. The rules under which worldwide elections are held determine who controls the executive and how votes are converted into legislative seats. The mechanics of various electoral arrangements will be examined in detail and the consequences for the political system discussed in terms of strategies and desired outcomes on the part of contestants. Students will research individual countries and analyze recent elections from both qualitative and quantitative perspectives, including introduction to geospatial data for mapping variations in electoral behavior. Offered as POSC 363 and POSC 463. Counts as SAGES Departmental Seminar.

POSC 464. Dictatorship and Democracy in Modern Latin America. 3 Units.
Examination of political leadership in 20th-century Latin America, exploring the nature, causes, and consequences of dictatorship and democracy in the region, moving from the collapse of oligarchic rule and the emergence of populism in the 1930s and 1940s, to the end of democracy and establishment of military regimes in the 1960s and 1970s, and ultimately to the contemporary processes of democratization and economic liberalization. Offered as ETHS 364, POSC 364, and POSC 464. Counts for CAS Global & Cultural Diversity Requirement.
POSC 466. Government and Politics of Africa. 3 Units.
Comparative analysis of the political forces and organizations currently functioning in Africa, as well as a survey of the formal government institutions. Special emphasis on single-party rule, military rule, and the political ramifications of African socialism, tribalism and the problems of national integration. Offered as ETHS 366, POSC 366, and POSC 466.

POSC 467. Western European Political Systems. 3 Units.
Comparative analysis of sociopolitical systems of selected Western European industrial democracies, using North American systems as a point of comparison. Offered as POSC 367 and POSC 467.

POSC 469. Ethnicity, Gender, and Religion in Latin American Politics and Society. 3 Units.
This course focuses on aspects of Latin America's social and political realities and dilemmas. It will first explore race, gender, and religion, and then tackle revolution, democracy and populism. Throughout, the entire region's history, geography, and culture(s) will be considered; for example, the European and indigenous legacies in Mexico and Peru, Bolivia, Chile, and Ecuador; the Asian presence in Peru and Brazil; the African contributions to Cuba and Brazil, female heads of state, such as Nicaragua's Violeta Chamorro, Chile's Michelle Bachelet, Argentina's Cristina Fernandez de Kirchner, Costa Rica's Laura Chinchilla, and Brazil's Dilma Rousseff. The class will explore Liberation Theology and the new Pope's worries about the declining number of Catholics in the region. Today's multiparty democracy in Mexico, Hugo Chavez's 14-year rule in Venezuela, and Cuba's international humanitarian aid would not be possible without revolution(s) and populism. They are intertwined with ethnicity, gender, and religion. Offered as ETHS 369, POSC 369 and POSC 469. Counts for CAS Global & Cultural Diversity Requirement.

POSC 470A. Political Economy. 3 Units.
Focus on debates concerning the proper relationship between political and economic systems, including conservative, liberal, and radical perspectives. The politics of international economics and the economics of international politics receive separate attention. The course concludes with study of "modern" political economy and the application of economic theory to the study of political systems. Offered as POSC 370A and POSC 470A.

POSC 470C. The United States and Asia. 3 Units.
Survey and analysis of U.S.-Asia relations in the post-World War II period. Focus specifically is on the interaction of politics and economics in the United States' relations with Japan, China, and Southeast Asian countries. Topics will include the role of Asia in U.S. Cold War policies, the dynamics of U.S.-Japan alliance politics, post-Cold War issues involving U.S. foreign policy toward Asia, a history and analysis of economic conflict cooperation, and an examination of the move toward Asia-Pacific "regionalism." Offered as POSC 370C and POSC 470C.

POSC 470D. The Politics of China. 3 Units.
Now more than ever, the Chinese state and society are facing tremendous economic, social, and political challenges. This course presents an overview of current issues facing the People's Republic, including a changing (or not) political culture, policy processes and outcomes at the national and local levels, reform and economic growth, the resultant societal changes and pressures, and the consequent challenges the Communist Party faces as demand for political reform grows. The class involves a mixture of lectures and discussion and draws on a combination of primary and secondary sources, including current news reports and films. Offered as POSC 370D and POSC 470D. Counts for CAS Global & Cultural Diversity Requirement.

POSC 470F. Financial Politics in the United States and the World. 3 Units.
This course explores how political institutions make policy in the financial area with particular emphasis on the United States. Using a bureaucratic politics framework, it examines money, banks and the securities industry by integrating a wide range of literature in economics and political science. Specific objectives include familiarizing students with different approaches to the political economy of finance from different disciplines, exploring the historical evolution of finance, examining the changing relationship between public and private authority within the financial system, considering how politics operates in a crisis, and evaluating the role of international financial institutions in the global economy. By taking this course, students will equip themselves for further research into politics and economics, as well as offer them tools to analyze future policy developments as they unfold. Offered as POSC 370F and POSC 470F.

POSC 470G. U.S. Intelligence and National Security. 3 Units.
Examination of the impact of the intelligence process on foreign policy making and superpower relations. Covers the life cycle of United States strategic intelligence from the collection of data to formulation of analytic judgments and the policy-level uses of intelligence. Emphasis on contemporary intelligence issues and processes, but includes the formative period of modern American intelligence in the World War II era. Offered as POSC 370G and POSC 470G.

POSC 470H. China's Foreign Policy. 3 Units.
The rise of China is evident in the country's more forward and robust foreign policy that began in 1979. At every turn, nations throughout the world must now consider China wherever their interests are at stake, be it Korea and Northeast Asia, Indochina and Southeast Asia, India/Pakistan and South Asia, or Afghanistan and Iran in the Middle East, not to mention the many African states that welcome Chinese investment but chafe at China's presence. Further, China is increasingly aggressive in international trade, a major determinant of its foreign policy. This course describes the key factors that make up Chinese foreign policy, including its cultural tradition, policy-making institutions, the role of the military, and domestic determinants of foreign policy. The course also examines China's ever-changing foreign policy strategies, from an aggressive posture to charming its neighbors only to become more strident once again. The course will also examine China's role involving possible mercantilism, currency manipulation, and the hunt for traditional and alternative energy sources. Throughout the course, we will pay attention to how China's foreign policy relates to international relations theories and what strategies might be used to manage China's growing role in international affairs. Offered as POSC 370H and POSC 470H. Counts for CAS Global & Cultural Diversity Requirement.

POSC 470J. International Law and Organizations. 3 Units.
Study of international organizations and international law as two means for regulating and coordinating nation-state behavior. History of the two techniques will be traced, covering 19th century efforts at cooperation, the League of Nations and the United Nations, regional and specialized global organization. The functions of international law in global politics will be stressed, with primary focus on the evolving role of law in dealing with global problems, e.g., war, the environment, economic cooperation, and human rights. Offered as POSC 370J and POSC 470J.

POSC 470K. Nationalism, Ethnicity, and Religion in World Politics. 3 Units.
Examination of the post-Cold War surge in conflicts among nationalisms, ethnic groups, and religions with particular attention to the former Yugoslavia, Ireland, India, Africa, and the Middle East. Offered as ETHS 370K, POSC 370K, and POSC 470K.
POS 470M. Theories of Political Economy. 3 Units.
This course is a SAGES departmental seminar in political economy that brings a wide range of theoretical perspectives to bear on the relations between market and state in the contemporary world. It focuses on three questions: What have been the major debates concerning the role of the government in the economy? How were these debates resolved in the compromise of embedded liberalism, and What experiences have individual states had with these questions of political economy? To answer these questions, we will read original literature to uncover the connections among politics, economics, and the world of ideas that has resulted in the political debates we confront today. Offered as POSC 370M and POSC 470M. Counts as SAGES Departmental Seminar.

POS 471. Natural Resources and World Politics. 3 Units.
Examination of the political causes and ramifications of the uneven distribution of the valuable natural resources for modern industrial societies. Strategic and military issues and the exploitation of the sea bed. Examination in some detail of selected commodity issues, including petroleum, copper and uranium. Offered as POSC 371 and POSC 471.

POS 472. Activism Beyond Borders: NGOs and International Advocacy. 3 Units.
This course examines the role of non-state actors, and particularly non-governmental organizations (NGOs) in world politics. We will begin with a survey of traditional theoretical approaches to international relations, so that students can be conversant in the basic theory and vocabulary of the discipline. We then examine the growing role of NGOs in world politics amidst the broader trend of globalization, and the academic and policy debates surrounding each. After this primer, the course will examine four "big questions" with respect to international activism: 1) When do NGOs mobilize? 2) What tactics do they use? 3) What explains success and failure in advocacy? 4) What are the broader political implications of a global class of elite advocates? Offered as POSC 372 and POSC 472.

POS 473. Politics of the European Union. 3 Units.
Study of the origins, operations, and prospects for the European Union. This can include the historical context for the effort to restrict national rivalries (which fueled two world wars) and create common interests; the diplomatic challenges in finding common ground; the tasks and processes of governance within the EU, including its governing institutions, enforcement of terms for European Monetary Union and the operations of its bureaucracies; the social pressures that create policy challenges (such as agriculture policy and immigration); broad tensions within the enterprise (e.g., "broadening" vs. "deepening"), and the EU’s potential place in international politics, especially the efforts to create a common foreign and security policy and the possible implications of the Euro for international political economy. Offered as POSC 373 and POSC 473.

POS 474. Politics of Development in the Global South. 3 Units.
Exploration of the post-World War II emergence of the Global South nations of Africa, Asia, the Middle East, Latin America, and the Eastern Europe arena. Offered as ETHS 374, POSC 374, and POSC 474.

POS 475. The International Politics of Technology. 3 Units.
Technology is deeply political. Nowhere is this statement more evident than in the realm of international relations, where governments perceive technology as a source of power and wealth and a symbol of relative position and modernity. Yet for centuries skeptics have questioned the economic rationale of government technology policies. Still, to this day, countries support emulation, innovation and a host of other strategies as means for catching up with leading nations or locking in current advantages. What lies behind such policies? What do they accomplish? And what are the domestic and international politics surrounding them? After reading classic arguments, including texts by Adam Smith, Alexander Hamilton and Friedrich List, students will consider 20th and 21st century debates and an array of experiments tried by poor, middle-income and rich countries. Cases include the development of new industries; the imposition of sanctions; the dilemma of dual technologies and military spillovers; the forging of national champions; the reorganization of banks and the creation of international financial centers; the copying of regional clusters (e.g. Silicon Valley) and stock markets (e.g. the Nasdaq); and the extraterritorial extension of domestic regulation and governance techniques. There are no prerequisites and first year students are welcome. Offered as POSC 375 and POSC 475. Counts as SAGES Departmental Seminar.

POS 476. United States Foreign Policy. 3 Units.
Focus on U.S. foreign policy making with a dynamic network of executive and congressional actors and organizations; analysis of traditional and contemporary U.S. foreign policies from nuclear defense to current economic resource issues; future role of the United States in world affairs. Offered as POSC 376 and POSC 476.

POS 477. Politics of Russia. 3 Units.
Russia faces three problems: the creation of a sovereign state, the development of a new political system, and the restructuring of its economy. In this course we will challenge the assumption that the outcome of these three transitions will be a strong, democratic, capitalist country. We will ask whether civil war, organized crime, an immature party system, poor social services, and nomenklatura privatization bode poorly for these three transformations. Offered as POSC 377 and POSC 477. Counts for CAS Global & Cultural Diversity Requirement.

POS 478. International Relations Theory. 3 Units.
This course is a seminar in international relations theory. As such, we will bring a wide range of theoretical perspectives to bear on issues and debates in the area of international relations by systematically studying the evolution of the world system. The seminar is roughly divided into a first half focusing on war and the political system, and a second half focusing on trade, finance and the economic system. Each section devotes particular attention to ethical problems associated with political and economic issues. This course should develop students’ ability to read and critically evaluate academic literature in the field of international relations, and enable students to produce a scholarly paper on one substantive area of the field. Offered as POSC 378 and POSC 478. Counts as SAGES Departmental Seminar.
POSC 479. Introduction to Middle East Politics. 3 Units.
This is an introductory course about Middle East Politics, in regional as well as international aspects. In this course we will explore broad social, economic, and political themes that have defined the region since the end of World War Two. Since this is an introductory course, a major goal will be to gain comparative knowledge about the region’s states and peoples. The countries that comprise the modern Middle East are quite diverse; therefore, we will only be able to focus on a few cases in depth. A second goal is to use the tools and theories social scientists employ to answer broad questions related to the region, such as: How have colonial legacies shaped political and economic development in the Middle East? How do oil, religion, and identity interact with politics? How have external powers affected the region’s political development? What do the uprisings of 2011 hold for the region’s future? Offered as POSC 379 and POSC 479. Counts for CAS Global & Cultural Diversity Requirement.

POSC 481. City as Classroom. 3 Units.
In this course, the city is the classroom. We will engage with the urban terrain. We will meet weekly off-campus, interact with community members, and interface—both literally and figuratively—with the city as a way to examine the linkages between historical, conceptual, and contemporary issues, with particular attention paid to race and class dynamics, inequality, and social justice. This course will have four intersecting components, primarily focusing on American cities since the 1930s: the social and physical construction of urban space, the built environment, life and culture in the city, and social movements and grassroots struggles. Offered as HSTY 381, POSC 381, SOCI 381, HSTY 481, POSC 481, and SOCI 481. Counts for CAS Global & Cultural Diversity Requirement.

POSC 483. Health Policy and Politics in the United States. 3 Units.
Overview of the principal institutions, processes, social forces, and ideas shaping the U.S. health system. Historical, political, economic, and sociological perspectives on the health system are explored as well as the intellectual context of recent policy changes, challenges, and developments. Students will acquire a sense of how health services are financed and delivered in the U.S. They will also learn how to assess its performance compared to that of other similar countries. Offered as POSC 383 and POSC 483.

POSC 484. Ethics and Public Policy. 3 Units.
Evaluation of ethical arguments in contemporary public policymaking discourse. That is, approaches to evaluating not only the efficiency of policy (Will this policy achieve its end for the least cost?) but also the ethics of policy (Are a policy’s intended ends ethically justified or “good,” and are our means to achieve those ends moral or “just”?). Overview of political ideologies that supply U.S. political actors with their ethical or moral arguments when proposing and implementing public policy, followed by an application of these differing perspectives to selected policy areas such as welfare, euthanasia, school choice, drug laws, censorship, or others. Offered as PHIL 384, PHIL 484, POSC 384 and POSC 484.

POSC 485. U.S. Bureaucratic Politics. 3 Units.
Bureaucracy is one of civilization’s most important inventions. It is a way of coordinating very large numbers of people so as to do work, make decisions, and exercise power. Without it, much of modern life would be impossible. Yet “bureaucracy” is normally seen, in public discussion, as a problem, instead of as a solution. This course will consider both the reasons for and pathologies of bureaucratic organization. Its special focus is bureaucracy in American government. The course therefore will provide some introduction to the study of American public administration, but with special emphasis on how the work and performance of public bureaucracies in the United States is shaped by the specific tasks they are given and the distribution of power in the American political arena. Offered as POSC 385 and POSC 485. Counts for SAGES Departmental Seminar.

POSC 486. Making Public Policy. 3 Units.
Politics is about who wins, who loses, and why. Policy, by contrast, is often depicted as more “neutral;” policies are the means through which political decisions are carried out. In this class, we examine the notion that policy is the rational, impartial counterpart to the political arena. We will ask: How are public policies made? Why do some issues make it on to the agenda, while others do not? Can we separate facts from values, or are both always contested? We will examine how decision-making in a group introduces distinct challenges for policymaking. The course focuses on widely applicable themes of policymaking, drawing on both domestic and international examples. Offered as POSC 386 and POSC 486.

POSC 488. Politics, Policy, and the Global Environment. 3 Units.
This course examines the law, politics and policy surrounding global environmental challenges such as climate change. The course aims to provide a broad overview of the key concepts, actors, debates, and issues in global environmental politics. It aims to illustrate the complexities of addressing environmental problems--from the proliferation of global institutions and international actors, to the absence of central enforcement mechanisms. We examine the causes of environmental degradation and competing views on the gravity of the problem. Using concepts from political science and economics, we investigate the challenges in getting states to act jointly to address environmental problems. We examine the actors and institutions of global environmental politics, to understand how conditions are defined as problems and responses are chosen and implemented. The course concludes by applying the tools and concepts to the case of climate change. Offered as ESTD 388, POSC 388 and POSC 488.

POSC 489. Special Topics in American Politics and Policy. 3 Units.
Specific topic will vary but will consist of an in-depth investigation of a particular policy area or political phenomenon. Topics will involve policy controversies of some current interest. Offered as POSC 389 and POSC 489.

POSC 490. Special Topics in International Relations. 3 Units.
This course will vary semester to semester and will focus on International Relations topics such as statecraft and diplomacy in contemporary world affairs; weak states and international sovereignty; and transnational soft law. A description of the topic(s) being covered will be available on the political science website each semester that the course is offered. Students may take this course more than once for up to 9 credits, when different topics are covered. Offered as POSC 390 and POSC 490.
POS 491. Special Topics in Comparative Politics. 3 Units.
This course will vary semester to semester and will focus on comparative politics topics involving political issues and/or controversies of some current interest. These may include some of the following: federal vs unitary political systems, nationalism and national identity, independence movements in developed countries, comparative political behavior, national and supranational political organization, comparative public policy, political violence and violent conflict, comparative political economy, varieties of democracy, the comparative politics of gender, comparative race and ethnicity, among others. A description of the specific course topic focus will be available on the political science website each semester that the course is offered. Students may take this course more than once (up to 9 credits) so long as the topics are different. Offered as POSC 391 and POSC 491.

POS 495. Independent Study. 3 Units.
Graduate level independent study taken for a grade.

POS 601. Individual Investigation. 1 - 6 Units.
The student must submit to the departmental office a project prospectus form, approved and signed by the faculty project supervisor, no later than the end of the second week of classes. The prospectus must outline the goals of the project and the research methodology to be used and is part of the basis for grading. The prospectus form is available from the departmental office. Prereq: Departmental prospectus form, graduate standing, and consent of department.

POS 651. Thesis M.A.. 1 - 6 Units.
Independent study of a research question and completion of a major research paper. An approved prospectus is required. Prereq: Graduate standing.

POS 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Public Policy Program

113 Mather House
http://artsci.case.edu/public-policy/
Phone: 216.368.2424
Joseph White, Program Director
joseph.white@case.edu

A minor in public policy is available to undergraduates in the College of Arts and Sciences and in the economics and management programs in the Weatherhead School of Management. The course requirements are in four categories: the public policy process; economic analysis; policy or political institutions or history; and a specific policy field. Courses are listed in the "Undergraduate" section (see link above). Substitutions can be made under exceptional circumstances, at the discretion of the program director.

Undergraduate or graduate courses with public policy content are offered through the Departments of Anthropology, Earth, Environmental and Planetary Sciences, History, Political Science, and Sociology in the College of Arts and Sciences; through the Department of Economics and other departments in the Weatherhead School of Management; through the School of Law, the School of Medicine, and the Frances Payne Bolton School of Nursing; and through the Jack, Joseph and Morton Mandel School of Applied Social Sciences. Students can engage with policy issues both through courses and through the extracurricular programming of the Center for Policy Studies and other university bodies.
The Department of Religious Studies offers both undergraduate (Bachelor of Arts) and graduate (Master of Arts) degrees. Undergraduates may pursue either a major or minor in the department; outstanding students may apply to the departmental honors program. Both the major and minor programs acquaint students with significant religious texts and traditions and with the cultures and societies in which these traditions are grounded. Majors are encouraged to participate in study abroad programs.

Where appropriate, courses are designed to utilize Internet and other technological resources, cultural institutions in University Circle, and the cultural diversity of Greater Cleveland. Several 300-level courses may be taken for graduate credit by fulfilling additional course requirements. The Department of Religious Studies also contributes courses to and supports a number of the college’s interdisciplinary programs and centers, such as Asian Studies, Environmental Studies, Ethnic Studies, Women’s and Gender Studies, International Studies, and Judaic Studies.

The academic study of religion, combined with appropriate courses in other fields, provides an excellent background for any professional career that involves interaction with diverse populations—including law, engineering, medicine and health care professions, journalism, and social work—and for graduate studies in a number of fields. A major in religious studies provides a well-rounded liberal arts education or can be combined conveniently with a second major. A minor in religious studies complements and broadens any field chosen as a major.

**Undergraduate Programs**

**Major**

Students majoring in religious studies must complete a minimum of 30 semester hours. Requirements for the major are as follows:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>RLGN 201</td>
<td>Interpreting Religion: Approaches and Current Issues</td>
<td>3</td>
</tr>
<tr>
<td>RLGN 395</td>
<td>Honors Research II</td>
<td>3</td>
</tr>
<tr>
<td>Or 399 Major/Minor Seminar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two sections (6 credits) of RLGN 150-numbered courses (151, 152, 153, 154, 155)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Two sections (6 credits) of RLGN 170-numbered courses (171, 172, 173)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Four electives, with at least two being 300-level **</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
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<td>30</td>
</tr>
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**Minor**

A minor in religious studies requires at least 18 credit hours, to include:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>RLGN 201</td>
<td>Interpreting Religion: Approaches and Current Issues</td>
<td>3</td>
</tr>
<tr>
<td>RLGN 399</td>
<td>Major/Minor Seminar</td>
<td>3</td>
</tr>
<tr>
<td>Three electives (9 credits) *</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

* Subsequent course selections (totaling 9 credit hours) will be determined in consultation with the student’s major advisor and should display some diversity in themes and topics.

**General Information**

The department offers a graduate program leading to a Master of Arts degree in Religious Studies. This two-year program concentrates on method and theory in the study of religion. The MA is designed to give students from a variety of backgrounds a solid foundation in the methods used in the contemporary study of religion.

**Program Curriculum**

**First Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundational Readings in Religious Studies (RLGN 400)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>One 400-level RLGN course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>An elective dealing with the method and theory in the study of religion</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>An elective dealing with method and theory in the study of religion</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Independent Study with thesis advisor to prepare proposal. To be approved by the graduate faculty by the beginning of the third semester.</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>One 400-level RLGN course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Year Total:</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>One 400-level RLGN course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Thesis M.A. (RLGN 651) (or elective)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Thesis M.A. (RLGN 651)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Thesis M.A. (RLGN 651)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Year Total:</td>
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<td>9</td>
</tr>
</tbody>
</table>

**Total Units in Sequence:** 30
Department Faculty

Timothy K. Beal, PhD
(Emory University)
Florence Harkness Professor of Religion and Chair
Biblical studies; Near Eastern studies; environmental studies; religion and culture; gender studies

Joy R. Bostic, PhD
(Union Theological Seminary)
Associate Professor
African-American religion; women and religion; U.S. urban religion

William E. Deal, PhD
(Harvard University)
Severance Professor in the History of Religion
Buddhism; East Asian religions; method and theory; religion and culture; cognitive science of religion and ethics

Justine Howe, PhD
(Northwestern University)
Assistant Professor
Anthropology of religion; Islamic studies

Deepak Sarma, PhD
(University of Chicago)
Professor
Hinduism; Indian philosophy; philosophy of religion; method and theory

Jonathan Tan, PhD
(The Catholic University of America)
Archbishop Paul J. Hallinan Professor in Catholic Studies; Associate Professor
Catholic Studies

Lecturers

Ramez Islambouli, MA
(Case Western Reserve University)
Full-time Lecturer
Islam; Islamic thought, Islamic law

Judith Neulander, PhD
(Indiana University)
Full-time Lecturer
Folklore, mythology; Jewish popular culture

Courses

RLGN 102. Introduction to the Study of Religion. 3 Units.
Introduction to the academic study of religion and of the religious dimensions of life. Open to all students but prerequisite for majors and minors in religious studies. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 108. The History of Yoga: The Yoga of Transformation and the Transformation of Yoga. 3 Units.
In this class we will investigate the history and context of yoga. We will first examine yoga as a transformative disciplined practice through close study of primary sources. Next we will focus on Yoga as presented in Patanjali's Yoga Sutras. We will then examine the ways and extent to which yoga has been transformed in both India and outside of India. To this end we will scrutinize the development of American(ized) "Yoga." We will address the legal complexities concerning ownership and appropriation as well as those concerning the teaching of "Yoga" in public schools and the establishment clause of the First Amendment. We will also devote several classes to actual yoga experiences where the students can learn some asana (postures) and movements. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 151. Introducing Africana Religions. 3 Units.
This "topics course offers an introduction to the academic study of Africana Religions. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and basic religious literacy in religions of people of African origins in sub-Saharan African, the Caribbean, Europe, and the Americas and thus will explore forms of these traditions in a diversity of cultural contexts. Section topics could include, but are not limited to: Introducing Africana Religions: The Black Church in the U.S., Introducing Africana Religions: Yoruba Ifa Traditions, Introducing Africana Religions: Orisha Traditions in Latin America and the Caribbean, Introducing Africana Religions: African American Religions, Introducing Africana Religions: U.S. African-derived Religions. Students may repeat the course for credit (up to 6 credits), provided that the two sections are different. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 152. Introducing Buddhism. 3 Units.
This "topics course offers an introduction to the academic study of Buddhism. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and basic religious literacy in Buddhist tradition, exploring forms of it in a diversity of cultural contexts in Japan and throughout the world. Section topics could include, but are not limited to: Buddhist Ethics, Buddhist Theory of Mind, The Sutras. Students may repeat the course for credit (up to 6 credits), provided that the two sections are different. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 153. Introducing Chinese Religions. 3 Units.
This "topics course offers an introduction to the academic study of Chinese religions. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and a basic religious literacy in the nuances and complexities in Chinese religions within various historical and socio-cultural contexts. Section topics might include, but are not limited to: Confucianism, Daoism, Chinese Buddhism, Gender and Sexuality in Chinese Religions. Students may repeat the course for credit once (two times total for 6 credits), provided that the two sections are different. Offered as RLGN 153, ETHS 153 and CHIN 253. Counts for CAS Global & Cultural Diversity Requirement.
RLGN 154. Introducing Hinduism. 3 Units.
This “topics” course offers an introduction to the academic study of Hinduism. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and basic religious literacy in Hinduism, exploring forms of it in a diversity of cultural contexts. Section topics could include, but are not limited to: The Epics, Ritual, Contemporary Practices. Students may repeat the course for credit (up to 6 credits), provided that the two sections are different. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 155. Introducing Jainism. 3 Units.
This “topics” course offers an introduction to the academic study of Jainism. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and basic religious literacy in Jainism exploring forms of it in a diversity of cultural contexts. Section topics could include, but are not limited to: Epic and Narratives, Ritual, Contemporary Issues. Students may repeat the course for credit (up to 6 credits), provided that the two sections are different. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 171. Introducing Christianity. 3 Units.
This “topics” course offers an introduction to the academic study of Christianity. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and a basic religious literacy in Christianity, exploring forms of it in a diversity of cultural contexts throughout the world. Section topics might include, but are not limited to: The Black Church, The Apocalyptic Imagination, Latin American Liberation Theology. Students may repeat the course for credit once (two times total for 6 credits), provided that the two sections are different. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 172. Introducing Islam. 3 Units.
This “topics” course offers an introduction to the academic study of the beliefs, practices, sacred texts, and intellectual traditions of Islam. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and basic religious literacy in Islamic tradition, including investigations into how Muslim institutions developed in relation to diverse socioeconomic and cultural conditions, including Africa, the Americas, the Middle East, and Europe. Section topics could include, but are not limited to: Women and Gender, Faith, Politics, and Modernity, Pilgrimages, Prophecy, and Sacred Places. Students may repeat the course for credit (up to 6 credits), provided that the two sections are different. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 173. Introducing Judaism. 3 Units.
This “topics” course offers an introduction to the academic study of Judaism. Whether approached through a particular theme or as a general historical introduction, each section of this course provides students with a general introduction to the academic study of religion and basic religious literacy in Jewish religious tradition, exploring forms of it in a diversity of cultural contexts around the world. Section topics could include, but are not limited to: Festivals and Holy Days, Women and Gender, Jewish Ethics. Students may repeat the course for credit (up to 6 credits), provided that the two sections are different. Offered as RLGN 173 and JDST 173. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 191. Introduction to Sanskrit. 3 Units.
This class is an introduction to Sanskrit language and culture. Students will learn basic Sanskrit grammar and syntax, both of which are inextricably linked to the culture of ancient South Asia. There are no prerequisites and the course does not presuppose any familiarity with India or Indian languages. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 201. Interpreting Religion: Approaches and Current Issues. 3 Units.
Introduction to academic study of religion, exploring the history and development of the field, important theories and methodologies, and current issues, debates, and horizons of research. The course is foundational for majors and minors in religious studies but also open to other interested students who may find it valuable for their work in other fields of study. Particular readings and other assignments will be determined by the designated instructor. Students are expected to attend class regularly, complete readings and other assignments, and participate actively in class discussions and other activities.

RLGN 203. Religious Studies for Future Healthcare Professionals. 3 Units.
This class will provide future healthcare professionals with the basic knowledge of religious studies and of topics pertaining to death and dying, sickness, suffering, and so on. Students will also gain a basic knowledge of related bioethical issues as they are found in the world’s religions. The primary aim of the course is to offer future healthcare professionals an awareness of the diverse religious backgrounds of patients and issues that they might encounter and to provide a basic understanding of religious studies in the process. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 204. Introduction to Asian Religions. 3 Units.
Principal Asian religious traditions based on a study of classical sources. Classical Chinese thought, Hinduism, and Buddhism. Readings include selections from the works of Confucius, Mencius, Mo Tzu, Lao Tzu, Chuang Tzu, the Mahabharata, the Bhagavad Gita, and the early Buddhist canon. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 205. Catholic Imagination: Global Perspectives. 3 Units.
This course introduces students to the diversity and plurality within the Catholic tradition as a world religion. It focuses attention on the global perspectives of Catholicism in recognition of the fact that more than two-thirds of the world’s Catholic population today are from the Global South or the Majority World. It will explore the challenges posed by, and the possibilities offered by studying the Catholic imagination as expressed in diverse and pluralistic forms through both historical experiences and contemporary perspectives. Students will also investigate the impact and implications of missionary expansion, religious reception, colonialism and imperialism, globalization, migration, transnationalism, postcolonialism, and multiple belonging on the transformation of Catholicism from a Eurocentric religious tradition to a truly globalized world religion. Students will also consider how subaltern and minoritized Catholics’ embrace of traditioning is reshaping traditional understandings of the Catholic imagination. Students will gain familiarity with how the central themes of the Catholic imagination are expressed in different ethnic, social, and cultural contexts around the world and appreciate the complexities of, and understand the implications arising from the global, transnational, and postcolonial dimensions of the Catholic imagination. Counts for CAS Global & Cultural Diversity Requirement.
RLGN 206. Religion and Ecology. 3 Units.
Historical and cross-cultural introduction to religious perspectives on nature and ecology, including Jewish, Christian, Hindu, Buddhist, and Native American texts and rituals. Themes include: ecology of chaos and complexity, urban ecology, wilderness, and ecological crises. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 208. Introduction to Western Religions. 3 Units.
Basic introduction to the three great monotheistic religions of the Western World: Christianity, Judaism, and Islam. All three of these religious traditions trace their roots to the faith of biblical Israel as revealed by a series of prophets including Noah, Abraham, and Moses. Each absorbed the philosophy and science of the Greco-Roman world and went on both to influence and struggle with each other. Many of the religious problems of the contemporary world, from Afghanistan to the Middle East to Yugoslavia, can be traced to tension within and between these religious groups. Offered as RLGN 208 and JDST 208. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 209. Introduction to Biblical Literature. 3 Units.
This course is an introduction to the academic study of biblical literature, including Hebrew Scriptures ("Old Testament") and the New Testament. The literature will be studied in light of both ancient and contemporary historical contexts, with a particular emphasis on the roles it plays in American culture and politics today. Class sessions will be discussion oriented and will involve close, careful analysis and interpretation of texts. No background in religion is necessary. Evaluation will be based on class preparation and participation, regular short writing assignments, two exams, and a major paper.

RLGN 211. Great Books of Western Religion. 3 Units.
Students will engage with the major writings that have shaped Western religious traditions (Christianity, Judaism, Islam) from their earliest expressions until the present day. Readings include the foundational Scriptures (Hebrew Bible, New Testament, Quran) of each tradition, religious poetry and other writings from the Middle Ages, and modern writers on spiritually and religiousness within each of these traditions. The course will be conducted as a seminar, in which students will read the selected original texts and will discuss their religious and spiritual meaning and significance in class. Each student will also prepare a final project based on the assigned authors or readings. Offered as RLGN 211 and JDST 211.

RLGN 212. Introduction to Christianity. 3 Units.
An introduction to the history, thought and culture of Christianity and its diverse traditions. Course will include field research with local Christian religious institutions.

RLGN 213. Jews and Judaism. 3 Units.
This course provides an introduction to Jewish religion, culture, history, and life. It does not presuppose any previous study of Judaism or experience with Judaism, and it prepares students for additional coursework in Judaic studies, Jewish history, or religious studies with an emphasis on Judaism. Required for the minor in Judaic Studies. Offered as JDST 101 and RLGN 213. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 214. Introduction to Islam. 3 Units.
This course is an introduction to the beliefs, practices, sacred texts, and intellectual traditions of Islam. We will approach the many dimensions of Islam from the perspectives of religious studies. Our goal is to develop a foundational understanding of the core aspects of Islam, while critically analyzing how these features have been understood in Western academic discourse. Throughout the term, we will examine major developments in the history of Islam, underscoring the dynamic changes that the tradition has undergone in its 1400+ year history. We will also investigate how Muslim institutions developed in relation to diverse socioeconomic and cultural conditions, including Africa, the Americas, the Middle East, and Europe. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 215. Religion In America. 3 Units.
This course is an introduction to American religions, with a particular focus on religious diversity in the United States. As we examine the myriad beliefs and practices of America's religious communities, we will pay close attention to how religion and culture have shaped each other from the 1600's to today. To explore the theme of religious diversity, we will take advantage of Cleveland's rich religious history with visits to local religious institutions and historical sites, including churches, mosques, synagogues and Hindu and Buddhist temples. Along the way we will consider the role of religious spaces and institutions in shaping community, identity, and politics in Northeast Ohio and beyond. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 216. Hinduism I: The Vedic, Epic and Puranic Periods. 3 Units.
This course will provide an introduction to the Vedic, Epic and Puranic periods in the development of Hinduism. We will read a range of primary sources produced during these times. These texts were composed between 1500 BCE and the 5th century CE. The course has an emphasis on research and writing. We will not be examining contemporary issues or practice. The goal of the class is to gain detailed understanding of the kind of world(s) that were envisioned in these forms of early "Hinduism."

RLGN 217. Buddhism. 3 Units.
Buddhism is an important world religion that originated in India around 500 BCE. Subsequently, Buddhism spread to Central and East Asia. More recently, Buddhist traditions have been established in Europe and North America. Like Christianity and Islam, Buddhism is considered a "missionary" religion because its message has been actively propagated in cultural contexts outside its place of origin. Buddhist ideas and concepts have not only inspired religious practice, but have often provided the foundation for political, social, ethical, literary, artistic and other modes of cultural expression. It is, therefore, difficult to understand those Asian cultures in which Buddhism is or has been important without understanding this religious tradition itself. This course examines concepts, symbols, and institutions central to Buddhist religious practice throughout its 2500 year history. We will focus on the Theravada and Mahayana Buddhist traditions as they developed in India, on the development of Pure Land and Zen traditions in China and Japan, and on Tibetan Buddhist traditions. We will also consider Buddhist perspectives on contemporary ethical issues. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 218. Faith and Politics in Islam. 3 Units.
An overview of the relationship between Islam as a religion and Islam as a political system and the effect of this relationship on Islamic society from its origin to the present time. Counts for CAS Global & Cultural Diversity Requirement.
RLGN 219. Islam in America. 3 Units.
The United States is home to one of the most diverse Muslim communities in the world. Using a variety of primary and secondary sources, this course examines the rich history of Islam in the United States, from the 18th century to the present, as it relates to key moments within American politics, religion and culture, and to transnational developments in Islamic thought and practice. We will also explore important issues within contemporary Muslim communities, including gender, shari’a, and religious pluralism. In addition to studying the experiences of Muslim immigrants, students will also investigate the vital role of African-American Muslims and converts in the development of American Muslim institutions, beliefs and rituals. This course will also introduce students to the history of Islam in Cleveland, and provide them with the opportunity to contribute to original research on Muslim communities in our city. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 221. Indian Philosophy. 3 Units.
We will survey the origins of Indian philosophical thought, with an emphasis on early Buddhist, Hindu and Jain literature. Our concern will be the methods, presuppositions, arguments, and goals of these schools and trajectories of thought. What were their theories on the nature of the person, the nature of reality, and the nature and process of knowing? What were the debates between the schools and the major points of controversy? And, most importantly, are the positions/arguments internally incoherent? Offered as PHIL 221 and RLGN 221. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 222. African-American Religions. 3 Units.
This course is an exploration of the rich diversity of African American religions from the colonial period to the present. Attention will be given to key figures, institutional expressions, and significant movements in African American religious history. Major themes include African traditions in American religions, slavery and religion, sacred music, social protest, Black Nationalism in religion, Islam, African American women and religion, and black and womanist theologies. Course requirements will include field trips to local religious sites. Offered as ETHS 222 and RLGN 222.

RLGN 223. Religious Roots of Conflict in the Middle East. 3 Units.
The course is about the rhetoric and symbols used by various voices in the Middle East in the ongoing debate about the future shape of the region. For historical and cultural reasons, much of the discourse draws on religious symbolism, especially (although not exclusively) Islamic, Jewish and Christian. Because of the long and complex history of the region and the religious communities in it, virtually every act and every place is fraught with meaning. The course examines the diverse symbols and rhetorical strategies used by the various sides in the conflict and how they are understood both by various audiences within each community and among the different communities. Offered as J DST 223 and RLGN 223. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 224. The Many Faces of Contemporary U.S. Catholicism. 3 Units.
This course explores the implications of immigration and changing demographics on the contemporary U.S. Catholic Church. The course investigates the diverse racial and ethnic communities that increasingly define U.S. Catholicism and includes a particular focus on Africans and African Americans, Latina/os, and Asian Americans. Attention will be given to the intersections of faith, ethnicity, race, and identity constructions in contemporary U.S. Catholicism, as well as issues of racism and racial justice in the U.S. Catholic Church and other social, cultural, and political dynamics that are shaping and transforming contemporary Catholic identities in the United States. Offered as ETHS 224 and RLGN 224. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 227. Women, Gender, and Islam. 3 Units.
Women and gender are central to understanding Muslim societies, past and present. From debates about the veil to the wars in Iraq and Afghanistan, gendered concerns have been especially prominent in contemporary debates about the status of Islam in the modern world. How have Muslim thinkers interpreted Islamic scriptures with respect to topics such as marriage, child custody, inheritance, and sexuality? How is masculinity and femininity constructed? In what ways do their interpretations reflect the political, economic, and social conditions in which they lived? How does gender structure authority and power in Muslim communities? How and why have Muslim women become so important in contemporary debates over religious and national identity around the world? This course begins by examining the position of women and gender in the foundational Islamic texts, the Qur’an and Sunna (the practice of the Prophet Muhammad), and pre-modern interpretations of them. Then we will explore marriage and divorce in Muslim jurisprudence, in order to examine themes such as women’s spiritual capacities, female leadership, sexuality, and slavery. Next, we will turn to the headscarf as a lens though which to explore modern configurations of gender and sexuality, as they intersect with conceptions of national belonging, religious identity, and individual freedom. Finally, we will study contemporary debates over polygyny, homosexuality, and female religious authority. There are no prerequisites for this course. No prior knowledge of Islam is expected. Offered as RLGN 227 and WGST 227. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 229. Asian Christianity: Historical Perspectives. 3 Units.
The history of Christianity in Asia is as old as the history of Christianity itself. But while much has been told about Christianity as it grew from an obscure Jewish sect to mighty Western Christendom, not enough attention has been given to the Christianity which spread eastwards to Asia in the first millennium of the Christian era. This course seeks to correct the imbalance by introducing students to a historical exploration of the eastward movement of Christianity from Jerusalem to different parts of Asia. Topics include the Assyrian Church of the East in Persia, India and China, European Catholic and Protestant colonial missions in the age of European imperialism, and the Jesuit missions to Japan and China. By the end of the semester, students should have a good grasp of the historical encounter of Christianity with the political, social, cultural and religious realities of Asia. Its dialogue and confrontation with these realities and the forces that led to its growth and decline. Offered as HSTY 229 and RLGN 229. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.
RLGN 232. DESI: Diaspora, Ethnicity, Southasia(n), Interrogate. 3 Units.
In this class we will interrogate the cultural identity(ies) and imagined community(ies) of the “South Asian” Diaspora. We will first examine taxonomy and categorization itself, as a methodical, philosophical, and political enterprise. We will then examine how such contended categories have been applied to the so-called desis, loosely and broadly understood as members of the South Asian Diaspora. To this end we will scrutinize the development of American(ized) “Hinduism,” the imagined location that desis have in North American racial and ethnic hierarchies, and the construction of assimilated, encultured, and transnational imagined desi communities. Offered as RLGN 232 and ETHS 232. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 233. Introduction to Jewish Folklore. 3 Units.
Exploration of a variety of genres, research methods and interpretations of Jewish folklore, from antiquity to the present. Emphasis on how Jewish folk traditions and culture give us access to the spirit and mentality of the many different generations of the Jewish ethnic group, illuminating its past and informing the direction of its future development. Offered as ANTH 233, RLGN 233, and JDST 233. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 235. Religion and Visual Culture. 3 Units.
Cross-cultural introduction to complex relations between religion and seeing. Study of visual culture, sacred iconography, calligraphy, film, mass media, and avant-garde fashion. Extensive use of cultural resources in University Circle.

RLGN 237. Religion and Dance in South Asia. 3 Units.
This is an experimental interdisciplinary course in religion, dance, and South Asian studies. We will explore the performance of religion in bharata natyam, one storytelling dance form from South Asia. This dance style draws upon Hindu devotional (bhakti) allegories of sacred and profane love in its choreography. Lover and beloved, as the ideal relationship between God and the human, becomes the model for the performed relationship between heroes and heroines (nayaka-nayaki) danced on stages and, more recently, Bollywood screens. To this end we will examine primary and secondary sources on bharata natyam and aesthetic theory/classical dramas. We will also observe dance performances in the greater Cleveland area. Offered as RLGN 237 and DANC 237.

RLGN 238. Alternative Altars: Folk Religion in America. 3 Units.
Taking a multidisciplinary approach, students will become familiar with the distinction between conventional and unconventional religions, with the history and personalities associated with new belief systems in America, and with the means, motivations and methods of generating faith communities. Students will come to understand the role of cultural anxieties, new technologies, changing roles, globalization and other social tensions in the formation and duration of alternative altars. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 240. The Heavens in Religion and Science. 3 Units.
Review of the relationships between scientific descriptions of the natural world and the religious and ethical implications drawn from those in Western civilizations. Introduction to the close cooperation between religion and science in the West until the modern period and review of the breakdown of that relationship in the past 200 years. Counts as SAGES Departmental Seminar.

RLGN 251. Perspectives in Ethnicity, Race, Religion and Gender. 3 Units.
This course is designed to introduce students to the study of ethnicity. Basic concepts such as race, gender, class, and identity construction will be examined. Students are encouraged to use the tools and perspectives of several disciplines to address the experiences of ethnic groups in the United States. Offered as ETHS 251 and RLGN 251. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 254. The Holocaust. 3 Units.
This class seeks to answer fundamental questions about the Holocaust: the German-led organized mass murder of nearly six million Jews and millions of other ethnic and religious minorities. It will investigate the origins and development of racism in modern European society, the manifestations of that racism, and responses to persecution. An additional focus of the course will be comparisons between different groups, different countries, and different phases during the Nazi era. Offered as HSTY 254, RLGN 254, ETHS 254, and JDST 254. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 260. Introduction to the Qur’an. 3 Units.
This course is an introduction to the Qur’an. For Muslims, the Qur’an is the inimitable word of God, and its influence has been both far-reaching and profound in various historical contexts. It introduces students to the text of the Qur’an, in English translation, providing a window into both Muslim interpretations of their scripture (from the early days of Islam to the present) and academic studies of the text. Students will approach the Qur’an as a living document, as text that is continually re-visited and re-interpreted by Muslims, and used in various ritual contexts and in daily life. This course will explore theological and legal dimensions of the Qur’an, touching on issues of God’s nature, Islamic ethics, the foundations of Islamic law, and gender roles. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 265. Malcolm and Martin. 3 Units.
An examination of the lives, religious thought, and ideological frameworks of Malcolm X and Martin Luther King, Jr. The course will investigate Malcom X and Martin King’s religious beliefs and activist strategies; the ideas and strategies of other civil rights and Black Nationalist leaders who influenced and challenged Martin and Malcom’s ideas on race, gender, class, and sexuality; and the historical antecedents for these strategies within nineteenth-century black religious, social, and political movements. Their impact on modern African American religious thought, American political culture, and international human rights movements will also be explored. Offered as ETHS 265 and RLGN 265. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 268. Women in the Bible: Ethnographic Approaches to Rite and Ritual, Story, Song, and Art. 3 Units.
Examination of women in Jewish and Christian Biblical texts, along with their Jewish, Christian (and occasionally Muslim) interpretations. Discussion of how these traditions have shaped images of, and attitudes toward, women in western civilization. Offered as RLGN 268, WGST 268, and JDST 268.

RLGN 270. Introduction to Gender Studies. 3 Units.
This course introduces women and men students to the methods and concepts of gender studies, women’s studies, and feminist theory. An interdisciplinary course, it covers approaches used in literary criticism, history, philosophy, political science, sociology, anthropology, psychology, film studies, cultural studies, art history, and religion. It is the required introductory course for students taking the women’s and gender studies major. Offered as ENGL 270, HSTY 270, PHIL 270, RLGN 270, SOCI 201, and WGST 201. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.
RLGN 272. Morality and Mind. 3 Units.
Recent research in cognitive science challenges ethical perspectives founded on the assumption that rationality is key to moral knowledge or that morality is the product of divine revelation. Bedrock moral concepts like free will, rights, and moral agency also have been questioned. In light of such critiques, how can we best understand moral philosophy and religious ethics? Is ethics primarily informed by nature or by culture? Or is ethics informed by both? This course examines 1) ways in which cognitive science— and related fields such as evolutionary biology— impact traditional moral perspectives, and 2) how the study of moral philosophy and comparative ethics forces reconsideration of broad cognitive science theories about the nature of ethics. The course examines the concept of free will as a case study in applying these interpretive viewpoints. Interdisciplinary readings include literature from moral philosophy, religious ethics, cognitive science, and evolutionary biology. Offered as COGS 272 and RLGN 272.

RLGN 273. Religion and Healing in the United States. 3 Units.
A cross-cultural exploration of the relationships between religion, health, and healing in the United States. Through an interdisciplinary approach that includes religious studies, medical anthropology and ethnic/gender studies, the course investigates how persons interpret illness and suffering. Attention is also paid to how different groups utilized, or are served by, the health care system. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 278. Religion and Popular Culture. 3 Units.
How does religion function when it shows up in popular culture? How does popular culture influence and shape religion? This "topics" course explores the interactions between religion and popular culture in contemporary society. Each section will focus on visual, kinetic, aural, haptic or literary "texts" that may include musical production, dance, film and television, social media, sports, video, visual and textile arts, traditional fiction or graphic novels. The course examines how religious traditions, symbols or concepts are evoked in popular cultural texts and how these texts create meaning and shape individual and communal identity. Each section will examine themes and issues that may include: gender, race, and sexuality; protest and activism, commercialism and consumerism; power and identity; ethics and morality; experience and embodiment; and constructions of evil, salvation, and transcendence. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 280. Religion and Politics in the Middle East. 3 Units.
An in-depth look at the relationship between politics and religion in the Middle East. Students will spend the first week on the CWRU campus and the last three weeks in Israel, where time will be divided between classroom teaching, guest lectures, and "field trips" to important sites. Students will have the opportunity to interact directly with members of the region's diverse religious groups within the political, social, and cultural contexts in which they live. A final research paper will be required. Knowledge of Hebrew is not necessary. Offered as JDST 280 and RLGN 280.

RLGN 283. Muhammad: The Man and the Prophet. 3 Units.
The life of the Prophet Muhammad (c.470-632 CE) which was as crucial to the unfolding Islamic ideal as it is today. An examination of how he attempted to bring peace to war-torn Arabia by evolving an entirely new perspective of the human situation, guidance for human lives, and humans' relationship with God. The course will include Western perceptions of Islam, especially in light of September 11, 2001.

RLGN 284. Jesus Through Islamic Lens. 3 Units.
Christians are often surprised when they hear Muslims say, "We believe in Jesus too, and we hold him in great esteem." But what do they really mean? Are the Muslim Jesus and the Christian Jesus the same person? The primarily aim of this course is to introduce an image of Jesus little known outside the Arabic Islamic culture. It is an image that might be of interest to those who wish to understand how Jesus was perceived by a religious tradition which greatly revered him but rejected his divinity. Hence, the Jesus presented in this course will be similar in some ways to the Jesus in the Christian Gospels, in others not. Why and how this Muslim tradition of Jesus arose will be also discussed in this course. Jesus Through Islamic Lens will draw from various Islamic texts to provide a comprehensive selection of excerpts pertaining to the life and moral teachings of Jesus. Approaching Christ from an Islamic perspective, this course will offer the students a rare opportunity to understand the significance of Jesus in Islam and to gain a better understanding of the faith, not only as it contrasts with Christianity but also as it compares. In this course we will try to respond to these questions: What role does Jesus have in Islam? What does the Quran say about Him? What does it not say? Why are Muslims repulsed by the idea that Jesus is the Son of God, fully God and fully man? What do Muslims have in mind when they acknowledge Jesus as virgin-born? This course also requires reading literature that pertains to the history of Islam, its theology and its culture, and because of its emphasis on an area of the world historically distinct from the West (or European culture), the course will fulfill the Global and Cultural Diversity requirement. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 301. Ritual in Religion. 3 Units.
Drawing from a broad range of approaches and academic fields, this seminar offers an introduction to the study of ritual. The course has three main goals: (1) to help students become familiar with important theories of and approaches to ritual studies; (2) to explore a number of ritual practices from different cultures, from ancient priestly rites in the Bible to contemporary cockfights in Bali; and (3) to study and discuss several representations of ritual in contemporary literature and film. Offered as RLGN 301 and RLGN 403.

RLGN 302. The Lemonade Class: Religion, Race, Sex and Black Music. 3 Units.
Charles Long suggests that black musical forms are creative responses to the particular circumstances of black peoples' presence in the U.S and black notions of the sacred. In April of 2016, Beyoncé released her visual album Lemonade two days after the death of Prince. This course is organized around the album's title cuts and links these two artists together in an examination of religion and musical performance as creative responses to the racial and gendered conditions of black life. The course investigates how both artists have used music as a platform to explore issues of race, gender, commerce, sexuality, power and divinity. The course also looks at examples from the works of earlier artists who address similar themes such as Ma Rainey, Bessie Smith, Muddy Waters, Billie Holiday, Nina Simone, Little Richard, James Brown, Marvin Gaye, and Aretha Franklin. Offered as ETHS 302, MUHI 316, RLGN 302, RLGN 402, and WGST 302. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 304. The Lemonade Class: Religion, Race, Sex and Black Music. 3 Units.
RLGN 304. Representations of Black Women and Religion in Film. 3 Units.
In this course we will explore cinematic representations of black women and religion in film. Each week we will view a film in class. We will begin the class with the film Imitation of Life and then the course with The Help. Throughout the course we will analyze the ways in which notations of gender, sexuality, intimate violence, and modern notions of race and color, have informed representations of black women and religion in film. In addition, we will discuss how these representations, in turn, have influenced cultural ideas about black women in the Americas. Offered as RLGN 304, RLGN 404, WGST 304, and ETHS 304. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 306. Interpreting Buddhist Texts. 3 Units.
Readings in translation of major texts from the Buddhist tradition. Special emphasis on problems of textual interpretation, historical context, Buddhist conceptions of the sacred, and Buddhist ethics.

RLGN 307. Body, Health and Medicine in Chinese Religions: Historical and Contemporary Perspectives. 3 Units.
This course critically evaluates the history and development of traditional Chinese approaches to health and medicine in the context of Chinese religious, philosophical, and socio-cultural history. It examines the constructions of the body in Chinese religious and philosophical thought across different historical periods and evaluates their significance and implications for understanding Chinese approaches to health and medicine. It discusses the conceptions of "health" and "good health" in ancient China, the distinction between "healing" and "curing" the development of the complementary yin-yang and five phases (wuxing) theories, understandings of nature (xing) and body (ti), the concept of qi as life force, and various microcosm-macrocosm analogies that emerged from Chinese religious and philosophical traditions. It explores how these religious and philosophical frameworks, beginning with the Daoist classic, Basic Questions in the Inner Classic of the Yellow Emperor (Huangdi Neijing Suwen) have evolved to undergird the development of diet, acupuncture, moxibustion, meditation, and various alchemical practices within Chinese holistic conceptions of health and practices of Traditional Chinese Medicine. Offered as RLGN 307, RLGN 407, CHIN 307, HSTY 308, and ETHS 307. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 308. Daoism: Visual Culture, History and Practice. 3 Units.
This course explores developments in the visual culture, history and practices of Daoist religious traditions in China from the third to twentieth centuries. Our historically and conceptually structured examination draws upon a balance of visual, textual, and material sources, while considering the various approaches scholars have employed to understand the history and development of Daoist traditions. Topics include: sacred scriptures and liturgies, biographies and visual narratives, iconography and functions of the pantheon of gods and immortals, views of the self and the body, practices of inner alchemy and self-cultivation, thunder deities and exorcism, dietetics and medicine and modes of meditation and ritual. Offered as ARTH 308, ARTH 408, and RLGN 308. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 310. Cognitive Science of Religion. 3 Units.
This course introduces theories and methods in the cognitive science of religion. Particular emphasis is placed on applying cognitive scientific concepts and theories to such religious issues as belief in deities, religious ritual, and morality. We examine such topics as the relationship of religious studies to evolution and cognition, cognitive theories or religious ritual, anthropomorphism and religious representation, religion as an evolutionary adaptation, and cognitive semantics and religious language. Course work includes student-led discussions, a research-intensive journal-length essay on a topic chosen in consultation with the Instructor, and presentation of research findings to the class. Course readings are taken from the humanities, the social sciences, and natural sciences. Offered as COGS 310, COGS 410, RLGN 310 and RLGN 410.

RLGN 311. Representations of Black Religion in Film. 3 Units.
In this course we will explore cinematic representations of black religion in the Americas and the Caribbean. Each week we will view a film representing diverse religious traditions such as Christianity, Candomble, Santeria, Vodou, and Islam. Films will include Cabin in the Sky, The Color Purple, Black Orpheus, The Serpent and the Rainbow, Malcolm X, Eve's Bayou, and The Princess and the Frog. Throughout the course we will analyze the ways in which notions of gender, the history of colonialism, modern notions of race, and geographical landscapes have informed representatives of black religion in film. In addition, we will discuss how these representations, in turn, have influenced cultural ideas of black religion in the Americas. Offered as RLGN 311, ETHS 311, and RLGN 411. Counts for CAS Global & Cultural Diversity Requirement. Prereq: RLGN 222 or ETHS 251 or ENGL 367 or by permission of Instructor.

RLGN 312. The Mythical Trickster. 3 Units.
Few literary figures have as wide a distribution, and as long a history, as the mythical Trickster. He is at once sacred and profane, creator and destroyer; an incorrigible duper who is always duped. Free of social and moral restraints he is ruled instead by passions and appetites, yet it is through his unprincipled behavior that morals and values come into being. How are we to interpret this amazing creature? Using folkloristic theories and ethnographic methods, we will come to understand the social functions and symbolic meanings of the cross-cultural Trickster, over time and across space. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 313. Topics in Biblical Literature. 3 Units.
A departmental "topics" seminar focused on advanced textual analysis and interpretation of particular biblical (including apocryphal) texts and the critical issues of method, theory, theology, and history that pertain to those texts. Reading assignments will be divided between close, exegetical analysis of small units of texts and the study of scholarly criticism of the same texts (commentaries, journal articles, critical notes). Evaluation will be based on class preparation and participation, weekly short papers, an exegetical paper focused on a particular pericope of the student's choice, and an interpretive paper based on exegesis of several related passages. Graduate students enrolled in the course as RLGN 413 will have the following additional requirements: (a) preliminary academic reading on the biblical material; (b) leadership/teaching of one seminar session on an academic theoretical or theological approach to the biblical text, including an additional meeting with the professor in preparation for that session; and (c) a longer final paper that critical engages the approach that was the focus of the seminar session s/he leads (15-20 pages, suitable for publication at an academic conference). Offered as RLGN 313 and RLGN 413. Prereq: RLGN 209 or permission of instructor.
RLGN 314. Mythologies of the Afterlife. 3 Units.
This course provides a multidisciplinary approach to the idea of an afterlife, and its manifestation in diverse cultures. We will examine the way varying views of the afterlife influence religion, popular culture and palliative care, and how human culture has shaped the heavens, hells, hauntings and holidays of diverse populations over time and across space. Students will come to see the afterlife as an integral part of human history and experience, not only because it helps people die with better hope, but because it helps them to live more richly. Offered as RLGN 314 and JDST 314.

RLGN 315. Heresy and Dissidence in the Middle Ages. 3 Units.
Survey of heretical individuals and groups in Western Europe from 500 - 1500 A.D., focusing on popular rather than academic heresies. The development of intolerance in medieval society and the problems of doing history from hostile sources will also be explored. Offered as HSTY 315 and RLGN 315. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 316. Christianity in China. 3 Units.
This course critically evaluates Christianity's long history in China, beginning with the "Luminous Religion" (Jingjiao) that was propagated by Assyrian Christian missionaries in Tang China (7th century CE), the missionary endeavors of Catholic and Protestant foreign missionaries and mission societies, the rise of indigenous Chinese Christianities that sought independence from foreign missionaries, the impact of communist rule and the Cultural Revolution, and current developments involving both the official government-approved churches (i.e., the Three Self Patriotic Movement and the Chinese Patriotic Catholic Association) on the one hand, and the house church movement (jiating jiaohui) on the other hand. Students will critically discuss and analyze the historical dimensions of Christianity's presence in China and engagement with various social, cultural, political, philosophical, and religious aspects of Chinese society, past and present, and consider the implications of emergent forms of contemporary indigenous Chinese Christian movements for the future of Chinese Christianity. Offered as RLGN 316, RLGN 416, HSTY 322, CHIN 316 and ETHS 326. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 317. Topics in Catholic Studies. 3 Units.
A departmental topics seminar for Catholic Studies that is focused on advanced interdisciplinary study of selected thematic issues in Catholic Studies. Students will read and discuss advanced critical readings and write book reports, response papers, and an in-depth research essay. Graduate students enrolled in the course as RLGN 417 will have additional readings, a longer final paper of publishable quality or presentation at an academic conference, and leadership/teaching of at least one seminar session under the supervision of the course instructor. Offered as RLGN 317 and RLGN 417. Prereq: RLGN 205.

RLGN 318. Christian Music: Historical and Global Perspectives. 3 Units.
Music has played an outsized role in the history and development of Christianity, from plainchant to polyphony, shape note singing to gospel, congregational hymns to contemporary genres and global musical expressions at Christian worship across different continents and cultures. Offered as an upper-division seminar for advanced undergraduate and graduate students, this seminar examines the history and development of Christian music around the world within the social, cultural, regional, ritual, and spiritual contexts that inspired their emergence and growth. While the primary approach in this seminar is historiographical, ethnomusicological principles may be utilized where appropriate to examine contemporary genres of Christian music from the Two-Thirds or Majority World. Offered as RLGN 318, RLGN 418, and MUHI 309. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 319. The Crusades. 3 Units.
This course is a survey of the history of the idea of "crusade," the expeditions of Western Europeans to the East known as crusades, the Muslim and Eastern Christian cultures against which these movements were directed, as well as the culture of the Latin East and other consequences of these crusades. Offered as HSTY 319 and RLGN 319. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 324. Landscapes and Pilgrimages: Spatial Theory in the Study of Religion. 3 Units.
This course employs spatial approaches and theories to examine the religious praxis and identities of individuals and communities. Working notions of space include physical, socio-political, cultural, imaginative, and ritual dimensions. We will examine the themes of mapping, memory and movement related to religious landscapes and geographies as well as issues related to social justice, gender, race, power, difference, and ecology. We will also investigate the spatial practices of individuals and communities. These practices may include pilgrimage to, and construction, of religious sites, ritual procession, walking, devotional practices, community activism, and artistic endeavors. Course requirements include student participation in field excursions to religious sites and spaces in the Cleveland area and the development of a photo essay or a mixed media project related to religious space. Offered as RLGN 324 and RLGN 424.

RLGN 326. The Holocaust and the Arts. 3 Units.
This course explores artistic output during the Holocaust, as well as responses to the Holocaust in various forms, including music, art, architecture, film, and literature. Offered as MUHI 326, JDST 326, HSTY 326 and RLGN 326 Counts for CAS Global & Cultural Diversity Requirement.

RLGN 333. Philosophy of Religion. 3 Units.
Topics include: classical and contemporary arguments for God's existence; divine foreknowledge and human freedom; the problem of evil and theodicy; nature and significance of religious experience; mysticism; varieties of religious metaphysics; knowledge, belief and faith; nature of religious discourse. Readings from traditional and contemporary sources. Recommended preparation for PHIL 433 and RLGN 433. PHIL 101 or RLGN 102. Offered as PHIL 333, RLGN 333, PHIL 433, and RLGN 433. Prereq: PHIL 101 or RLGN 102.
RLGN 338. Black Women and Religion. 3 Units.
This course is an exploration of the multidimensional religious experiences of black women in the United States. These experiences will be examined within particular historical periods and across diverse social and cultural contexts. Course topics and themes include black women and slave religion, spirituality and folk beliefs, religion and feminist/womanist discourse, perspectives on institutional roles, religion and activism, and spirituality and the arts. Offered as ETHS 339, RLGN 338 and WGST 339. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 343. Mysticism. 3 Units.
This class is an introduction to a central issue in the philosophy of religion concerning the nature of mystical and ineffable experiences. Are all mystical experiences the same? Is it possible to have an experience outside of language? What is the ontological and epistemological status of drug induced mystical experiences? Students will learn to write and present arguments against positions using the methods of philosophers of religion(s).

RLGN 345. Religion and Horror. 3 Units.
This seminar explores relations among religion, horror, and the monstrous in ancient scripture and contemporary horror. Course readings, discussions, and research projects approach the subject from two distinct but related directions: first, a focus on elements of horror and the monstrous in biblical and related ancient mythic and ritual texts; second, an examination of religious dimensions in the modern horror, especially as found in representations of monstrosity in literature and film. Offered as RLGN 345 and RLGN 445. Prereq: RLGN 102.

RLGN 350. Jewish Ethics. 3 Units.
An exploration of Jewish moral and ethical discourse. The first half of the course will be devoted to studying the structure and content of classical Jewish ethics on issues including marriage, abortion, euthanasia, and social justice. Students will read and react to primary Jewish religious texts. The second half of the course will focus on various modern forms of Judaism and the diversity of moral rhetoric in the Jewish community today. Readings will include such modern thinkers as Martin Buber and Abraham Joshua Heschel. Offered as JDST 350, RLGN 350, and RLGN 450. Counts as SAGES Departmental Seminar.

RLGN 352. Language, Cognition, and Religion. 3 Units.
This course utilizes theoretical approaches found in cognitive semantics—a branch of cognitive linguistics—to study the conceptual structures and meanings of religious language. Cognitive semantics, guided by the notion that conceptual structures are embodied, examines the relationship between conceptual systems and the construction of meaning. We consider such ideas as conceptual metaphor theory, conceptual blending, Image schemas, cross-domain mappings, metonymy, mental spaces, and idealized cognitive models. We apply these ideas to selected Christian, Buddhist, and Chinese religious texts in order to understand ways in which religious language categorizes and conceptualizes the world. We examine both the universality of cognitive linguistic processes and the culturally specific metaphors, conceptual blends, image schemas, and other cognitive operations that particular texts and traditions utilize. Offered as RLGN 352, RLGN 452, COGS 352 and COGS 452. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 353. Hindu and Jain Bioethics. 3 Units.
This course will provide both an introduction to basic Hinduism and Jainism and an introduction to Hindu and Jain bioethics. We will ask: How would a Hindu or a Jain respond to issues concerning euthanasia, abortion, and other topics of controversy. Are these answers altered in the North American context or in the light of recent technological changes? Offered as RLGN 353, RLGN 453, BETH 353, and BETH 453. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 370. Structuralism and Anthropology of Religion. 3 Units.
The anthropological study of religion attempts to understand individual religions as social constructs. As such, it investigates the phenomenon of religion as a general pattern of human behavior. It asks, among other things, why there are religions at all and what common characteristics, if any, religions share. Among the central concepts are notions of the sacred and the way the sacred is marked through individual behaviors and communal structures. This course introduces the philosophical and cognitive background to the anthropological study of religion and traces the ways in which this method has evolved and been applied over the last century and a half. Special emphasis will be placed on more recent developments, such as Structuralism, which focuses especially on the underlying structures of religions and religious organizations. Offered as RLGN 370 and RLGN 470.

RLGN 371. Jews under Islam and Christianity. 3 Units.
This course examines the social and political status of Jews under Muslim and Christian rule since the Middle Ages. Themes include interfaith relations, Islamic and Christian beliefs regarding the Jews, Muslim and Christian regulation of Jewry, and the Jewish response. Offered as HSTY 371, JDST 371 and RLGN 371. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 372. Anthropological Approaches to Religion. 3 Units.
The development of, and current approaches to, comparative religion from an anthropological perspective. Topics include witchcraft, ritual, myth, healing, religious language and symbolism, religion and gender, religious experience, the nature of the sacred, religion and social change, altered states of consciousness, and evil. Using material from a wide range of world cultures, critical assessment is made of conventional distinctions such as those between rational/irrational, natural/supernatural, magic-religion, and primitive/civilized. Recommended preparation: ANTH 102. Offered as ANTH 372, RLGN 372 and ANTH 472.

RLGN 373. History of the Early Church: First Through Fourth Centuries. 3 Units.
Explores the development of the diverse traditions of Christianity in the Roman Empire from the first through the fourth centuries C.E. A variety of New Testament and extra-Biblical sources are examined in translation. Emphasis is placed on the place of Christianity in the larger Roman society, and the variety of early Christian ideals of salvation, the Church, and Church leadership. Offered as HSTY 303 and RLGN 373. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 374. Reformation Europe, 1500-1650. 3 Units.
Origins and development of Protestantism, the Catholic Counter-Reformation, and the interaction between secular power and religious identity in Christian Europe. Offered as HSTY 309 and RLGN 374. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 388. Topics in Religion. 3 Units.
Critical assessment of selected topics of historical or current interest. Project must be accepted by a member of the department faculty prior to registration. Offered as RLGN 388 and RLGN 488.

RLGN 392. Independent Study. 1 - 3 Units.
Up to three semester hours of independent study may be taken in a single semester. Must have prior approval of faculty member directing the project.

RLGN 394. Honors Research I. 3 Units.
Intensive study of a topic or problem leading to the writing of an honors thesis. Requires RLGN 102 plus 9 RLGN credits and department approval. Prereq: RLGN 102 plus 9 RLGN credits.
RLGN 395. Honors Research II. 3 Units.
Intensive study of a topic or problem leading to the writing of an honors thesis. By department approval only. Prereq: RLGN 394 and by departmental approval.

RLGN 399. Major/Minor Seminar. 3 Units.
Capstone course primarily for majors and minors in religious studies. Allows students to interact with peers and faculty, reflect critically, and integrate their learning experiences. Prepares students to continue their learning in the discipline and in the liberal arts. Subject matter varies according to student and faculty needs and perspectives. May be repeated once for up to six credit hours. Counts as SAGES Senior Capstone. Prereq: RLGN 201.

RLGN 400. Foundational Readings in Religious Studies. 3 Units.
Structured as an Independent Study, this course is meant to familiarize the student with the major classical works and thinkers that have shaped the modern field of Religious Studies. Students will meet on a regular basis with the Instructor to discuss the theories and methods described in the literature.

RLGN 402. The Lemonade Class: Religion, Race, Sex and Black Music. 3 Units.
Charles Long suggests that black musical forms are creative responses to the particular circumstances of black peoples’ presence in the U.S. and black notions of the sacred. In April of 2016, Beyoncé released her visual album Lemonade two days after the death of Prince. This course is organized around the album’s title cuts and links these two artists together in an examination of religion and musical performance as creative response to the racial and gendered conditions of black life. The course investigates how both artists have used music as a platform to explore issues of race, gender, commerce, sexuality, power and divinity. The course also looks at examples from the works of earlier artists who address similar themes such as Ma Rainey, Bessie Smith, Muddy Waters, Billie Holiday, Nina Simone, Little Richard, James Brown, Marvin Gaye, and Aretha Franklin. Offered as ETHS 302, MUHI 316, RLGN 302, RLGN 402, and WGST 302. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 403. Ritual in Religion. 3 Units.
Drawing from a broad range of approaches and academic fields, this seminar offers an introduction to the study of ritual. The course has three main goals: (1) to help students become familiar with important theories of and approaches to ritual studies; (2) to explore a number of ritual practices from different cultures, from ancient priestly rites in the Bible to contemporary cockfights in Bali; and (3) to study and discuss several representations of ritual in contemporary literature and film. Offered as RLGN 301 and RLGN 403.

RLGN 404. Representations of Black Women and Religion in Film. 3 Units.
In this course we will explore cinematic representations of black women and religion in film. Each week we will view a film in class. We will begin the class with the film Imitation of Life and then the course with The Help. Throughout the course we will analyze the ways in which notations of gender, sexuality, intimate violence, and modern notions of race and color, have informed representations of black women and religion in film. In addition, we will discuss how these representations, in turn, have influenced cultural ideas about black women in the Americas. Offered as RLGN 304, RLGN 404, WGST 304, and ETHS 304. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 407. Body, Health and Medicine in Chinese Religions: Historical and Contemporary Perspectives. 3 Units.
This course critically evaluates the history and development of traditional Chinese religious approaches to health and medicine in the context of Chinese religious, philosophical, and socio-cultural history. It examines the constructions of the body in Chinese religious and philosophical thought across different historical periods and evaluates their significance and implications for understanding Chinese approaches to health and medicine. It discusses the conceptions of “health” and “good health” in ancient China, the distinction between “healing” and “curing,” the development of the complementary yin-yang and five phases (wu xing) theories, understandings of nature (xing) and body (ti), the concept of qi as life force, and various microcosm-macrocosm analogies that emerged from Chinese religious and philosophical traditions. It explores how these religious and philosophical frameworks, beginning with the Daoist classic, Basic Questions in the Inner Classic of the Yellow Emperor (Huangdi Neijing Suwen) have evolved to undergird the development of diet, acupuncture, moxibustion, meditation, and various alchemical practices within Chinese holistic conceptions of health and practices of Traditional Chinese Medicine. Offered as RLGN 307, RLGN 407, CHIN 307, HSTY 308, and ETHS 307. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 410. Cognitive Science of Religion. 3 Units.
This course introduces theories and methods in the cognitive science of religion. Particular emphasis is placed on applying cognitive scientific concepts and theories to such religious issues as belief in deities, religious ritual, and morality. We examine such topics as the relationship of religious studies to evolution and cognition, cognitive theories or religious ritual, anthropomorphism and religious representation, religion as an evolutionary adaptation, and cognitive semantics and religious language. Course work includes student-led discussions, a research-intensive journal-length essay on a topic chosen in consultation with the Instructor, and presentation of research findings to the class. Course readings are taken from the humanities, the social sciences, and natural sciences. Offered as COGS 310, COGS 410, RLGN 310 and RLGN 410.

RLGN 411. Representations of Black Religion in Film. 3 Units.
In this course we will explore cinematic representations of black religion in the Americas and the Caribbean. Each week we will view a film representing diverse religious traditions such as Christianity, Candomble, Santeria, Vodou, and Islam. Films will include Cabin in the Sky, The Color Purple, Black Orpheus, The Serpent and the Rainbow, Malcolm X, Eve’s Bayou, and The Princess and the Frog. Throughout the course we will analyze the ways in which notions of gender, the history of colonialism, modern notions of race, and geographical landscapes have informed representatives of black religion in film. In addition, we will discuss how these representations, in turn, have influenced cultural ideas of black religion in the Americas. Offered as RLGN 311, ETHS 311, and RLGN 411. Counts for CAS Global & Cultural Diversity Requirement.
RLGN 413. Topics in Biblical Literature. 3 Units.
A departmental "topics" seminar focused on advanced textual analysis and interpretation of particular biblical (including apocryphal) texts and the critical issues of method, theory, theology, and history that pertain to those texts. Reading assignments will be divided between close, exegetical analysis of small units of texts and the study of scholarly criticism of the same texts (commentaries, journal articles, critical notes). Evaluation will be based on class preparation and participation, weekly short papers, an exegetical paper focused on a particular pericope of the student's choice, and an interpretive paper based on exegesis of several related passages. Graduate students enrolled in the course as RLGN 413 will have the following additional requirements: (a) preliminary academic reading on the biblical material; (b) leadership/teaching of one seminar session on an academic theoretical or theological approach to the biblical text, including an additional meeting with the professor in preparation for that session; and (c) a longer final paper that critically engages the approach that was the focus of the seminar session s/he leads (15-20 pages, suitable for publication at an academic conference). Offered as RLGN 313 and RLGN 413.

RLGN 416. Christianity in China. 3 Units.
This course critically evaluates Christianity's long history in China, beginning with the "Luminous Religion" (Jingjiao) that was propagated by Assyrian Christian missionaries in Tang China (7th century CE), the missionary endeavors of Catholic and Protestant foreign missionaries and mission societies, the rise of indigenous Chinese Christianities that sought independence from foreign missionaries, the impact of communist rule and the Cultural Revolution, and current developments involving both the official government-approved churches (i.e., the Three Self Patriotic Movement and the Chinese Patriotic Catholic Association) on the one hand, and the house church movement (jiating jiaohui) on the other hand. Students will critically discuss and analyze the historical dimensions of Christianity’s presence in China and engagement with various social, cultural, political, philosophical, and religious aspects of Chinese society, past and present, and consider the implications of emergent forms of contemporary indigenous Chinese Christian movements for the future of Chinese Christianity. Offered as RLGN 316, RLGN 416, HSTY 322, CHIN 316 and ETHS 326. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 417. Topics in Catholic Studies. 3 Units.
A departmental topics seminar for Catholic Studies that is focused on advanced interdisciplinary study of selected thematic issues in Catholic Studies. Students will read and discuss advanced critical readings and write book reports, response papers, and an in-depth research essay. Graduate students enrolled in the course as RLGN 417 will have additional readings, a longer final paper of publishable quality or presentation at an academic conference, and leadership/teaching of at least one seminar session under the supervision of the course instructor. Offered as RLGN 317 and RLGN 417.

RLGN 418. Christian Music: Historical and Global Perspectives. 3 Units.
Music has played an outsized role in the history and development of Christianity, from plainchant to polyphony, shape note singing to gospel, congregational hymns to contemporary genres and global musical expressions at Christian worship across different continents and cultures. Offered as an upper-division seminar for advanced undergraduate and graduate students, this seminar examines the history and development of Christian music around the world within the social, cultural, regional, ritual, and spiritual contexts that inspired their emergence and growth. While the primary approach in this seminar is historiographical, ethnomusicological principles may be utilized where appropriate to examine contemporary genres of Christian music from the Two-Thirds or Majority World. Offered as RLGN 318, RLGN 418, and MUHI 309. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 424. Landscapes and Pilgrimages: Spatial Theory in the Study of Religion. 3 Units.
This course employs spatial approaches and theories to examine the religious praxis and identities of individuals and communities. Working notions of space include physical, socio-political, cultural, imaginative, and ritual dimensions. We will examine the themes of mapping, memory and movement related to religious landscapes and geographies as well as issues related to social justice, gender, race, power, difference, and ecology. We will also investigate the spatial practices of individuals and communities. These practices may include pilgrimage to, and construction, of religious sites, ritual procession, walking, devotional practices, community activism, and artistic endeavors. Course requirements include student participation in field excursions to religious sites and spaces in the Cleveland area and the development of a photo essay or a mixed media project related to religious space. Offered as RLGN 324 and RLGN 424.

RLGN 430. Genealogies of Religious Otherness. 3 Units.
Concepts of otherness pervade recent theories of religion. More or less related to one another, many of these concepts are borrowed from fields other than academic religious studies. This seminar explores the genealogies of otherness in theoretical discourse as they relate to religion. In the course of this seminar, our researches and discussions will address several key issues in academic religious studies, including: psychological and sociological processes of projection and their roles in the construction and deconstruction of religious identity; the significance of gender, sexuality, and ethnicity to these projections; concepts of otherness in mystical religious thought and experience; and the interrelations of order and chaos, figuring and disfiguring within religious ideas, institutions, and practices, interrelations that challenge common theoretical perspectives that treat religion primarily if not exclusively as a means of establishing order against chaos and as a force of social and ideological structure legitimation.

RLGN 433. Philosophy of Religion. 3 Units.
Topics include: classical and contemporary arguments for God’s existence; divine foreknowledge and human freedom; the problem of evil and theology; nature and significance of religious experience; mysticism; varieties of religious metaphysics; knowledge, belief and faith; nature of religious discourse. Readings from traditional and contemporary sources. Recommended preparation for PHIL 433 and RLGN 433: PHIL 101 or RLGN 102. Offered as PHIL 333, RLGN 333, PHIL 433, and RLGN 433.
RLGN 440. Insiders and Outsiders in the Study of Religion. 3 Units.
This course will provide an introduction to one of the most important theoretical and methodological issues in the social sciences and in religious studies, namely, the epistemic authority of the insider and of the outsider. We will read books and articles, both classical and contemporary, on the topic. My goal is to place students at the center of a contemporary debate in the study of religion. We will also examine both hypothetical and actual communities that uphold insider epistemologies.

RLGN 445. Religion and Horror. 3 Units.
This seminar explores relations among religion, horror, and the monstrous in ancient scripture and contemporary horror. Course readings, discussions, and research projects approach the subject from two distinct but related directions: first, a focus on elements of horror and the monstrous in biblical and related ancient mythic and ritual texts; second, an examination of religious dimensions in the modern horror, especially as found in representations of monstrosity in literature and film. Offered as RLGN 345 and RLGN 445.

RLGN 450. Jewish Ethics. 3 Units.
An exploration of Jewish moral and ethical discourse. The first half of the course will be devoted to studying the structure and content of classical Jewish ethics on issues including marriage, abortion, euthanasia, and social justice. Students will read and react to primary Jewish religious texts. The second half of the course will focus on various modern forms of Judaism and the diversity of moral rhetoric in the Jewish community today. Readings will include such modern thinkers as Martin Buber and Abraham Joshua Heschel. Offered as JDST 350, RLGN 350, and RLGN 450. Counts as SAGES Departmental Seminar.

RLGN 452. Language, Cognition, and Religion. 3 Units.
This course utilizes theoretical approaches found in cognitive semantics—a branch of cognitive linguistics—to study the conceptual structures and meanings of religious language. Cognitive semantics, guided by the notion that conceptual structures are embodied, examines the relationship between conceptual systems and the construction of meaning. We consider such ideas as conceptual metaphor theory, conceptual blending, image schemas, cross-domain mappings, metonymy, mental spaces, and idealized cognitive models. We apply these ideas to selected Christian, Buddhist, and Chinese religious texts in order to understand ways in which religious language categorizes and conceptualizes the world. We examine both the universality of cognitive linguistic processes and the culturally specific metaphors, conceptual blends, image schemas, and other cognitive operations that particular texts and traditions utilize. Offered as RLGN 352, RLGN 452, COGS 352 and COGS 452. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 453. Hindu and Jain Bioethics. 3 Units.
This course will provide both an introduction to basic Hinduism and Jainism and an introduction to Hindu and Jain bioethics. We will ask: How would a Hindu or a Jain respond to issues concerning euthanasia, abortion, and other topics of controversy. Are these answers altered in the North American context or in the light of recent technological changes? Offered as RLGN 353, RLGN 453, BETH 353, and BETH 453. Counts for CAS Global & Cultural Diversity Requirement.

RLGN 460. Approaches to the Study of Urban Religion. 3 Units.
This course will introduce students to basic concepts and tools used in sociology of religion drawing upon works from various theorists and sociologists of religion such as Nancy Ammerman, Peter Berger, and Robert Wuthnow. The course will analyze the relationship between the role and structure of religion in North America and the larger historical, cultural and social landscape. Utilizing the city of Cleveland as a resource, students will apply the tools and concepts learned to explicate how religious organizations impact, and are impacted by, urban environments.

RLGN 470. Structuralism and Anthropology of Religion. 3 Units.
The anthropological study of religion attempts to understand individual religions as social constructs. As such, it investigates the phenomenon of religion as a general pattern of human behavior. It asks, among other things, why there are religions at all and what common characteristics, if any, religions share. Among the central concepts are notions of the sacred and the way the sacred is marked through individual behaviors and communal structures. This course introduces the philosophical and cognitive background to the anthropological study of religion and traces the ways in which this method has evolved and been applied over the last century and a half. Special emphasis will be placed on more recent developments, such as Structuralism, which focuses especially on the underlying structures of religions and religious organizations. Offered as RLGN 370 and RLGN 470.

RLGN 488. Topics in Religion. 3 Units.
Critical assessment of selected topics of historical or current interest. Project must be accepted by a member of the department faculty prior to registration. Offered as RLGN 388 and RLGN 488.

RLGN 601. Special Research. 1 - 6 Units.
Project must be accepted by a member of the department faculty prior to registration. Prereq: Graduate standing.

RLGN 651. Thesis M.A.. 1 - 9 Units.
Project must be accepted by a member of the department faculty prior to registration.
crucial issues in diverse voices. The curriculum emphasizes the history, theory and practice of social justice work; the distribution of power, resources and opportunities; and appropriate individual and collective remedies for social injustice.

The Social Justice Institute was founded in 2010 under the direction of Dr. Rhonda Y. Williams.

The Social Justice minor is a total of 19 credits, including the required core course (SJUS 100 Introduction to Social Justice), a real-world seminar experience (SJUS 200 Social Justice Engagement Seminar: Experiential, Community Based Learning), and a senior research project (SJUS 398 Social Justice Capstone Project). In addition to the three required courses, students must take one course from each Focus Area below, plus one additional elective from any Focus Area.

The courses listed below are accepted toward the minor. Approved electives are added every year; students may request that relevant SAGES seminars be applied for elective credit.

**Focus Area 1: Ethics, Politics and Economics**

Are existing arrangements just? To what extent are current thought systems amenable to change? What are the preferred alternatives and how can they be realized?

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>HSTY/ETHS 393</td>
<td>Advanced Readings in the History of Race</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 316</td>
<td>African Political Thought</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 325/425</td>
<td>Philosophy of Feminism</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 334/ POSC 354/454</td>
<td>Political and Social Philosophy</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 384</td>
<td>Ethics and Public Policy</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 349</td>
<td>Social Inequality</td>
<td>3</td>
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</tbody>
</table>

**Focus Area 2: Social Inequality, Power and Privilege**

What is a fair distribution of resources? How do cultural practices, social relations, social structures and institutions reproduce, reduce or eliminate inequalities? What are the consequences of social inequality for health, development and well-being of individuals and communities? How are distributions and uses of power connected to social inequalities?

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>ETHS/WGST/FRCH/ WLIT 335/435</td>
<td>Women in Developing Countries</td>
<td>3</td>
</tr>
<tr>
<td>ETHS/WGST 352</td>
<td>African Feminisms</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 208</td>
<td>Social History of Crime</td>
<td>3</td>
</tr>
<tr>
<td>HSTY/WGST/ETHS 318</td>
<td>History of Black Women in the U.S.</td>
<td>3</td>
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<tr>
<td>HSTY 363/463</td>
<td>Gender and Sexuality in America</td>
<td>3</td>
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<tr>
<td>MPHP 306</td>
<td>History and Philosophy of Public Health</td>
<td>3</td>
</tr>
<tr>
<td>ORBH 370</td>
<td>Women and Men as Colleagues in Organizations</td>
<td>3</td>
</tr>
<tr>
<td>RLGN 338/WGST 339</td>
<td>Black Women and Religion</td>
<td>3</td>
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<tr>
<td>SOCI 202</td>
<td>Race and Ethnic Minorities in the United States</td>
<td>3</td>
</tr>
<tr>
<td>SOCI/WGST 326</td>
<td>Gender, Inequality, and Globalization</td>
<td>3</td>
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<tr>
<td>SOCI 349</td>
<td>Social Inequality</td>
<td>3</td>
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<tr>
<td>SOCI 355/455</td>
<td>Special Topics</td>
<td>3</td>
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<tr>
<td>SOCI 364</td>
<td>Disability and Society</td>
<td>3</td>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>SPAN 342</td>
<td>Latin American Feminist Voices</td>
<td>3</td>
</tr>
<tr>
<td>WGST/SOCI 201</td>
<td>Introduction to Gender Studies</td>
<td>3</td>
</tr>
</tbody>
</table>

**Focus Area 3: Social Movements and Social Change**

What are competing models of social change? What role have social movements played in U.S. and global history? How do social movements form? How have states responded to social movements? What is the relationship between democracy and social movements? How have different technological innovations advanced or impeded social movements? What knowledge and skills are necessary to implement social change?

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<tr>
<th>Course Code</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>HSTY/ETHS 280</td>
<td>History of Modern Mexico</td>
<td>3</td>
</tr>
<tr>
<td>HSTY 381</td>
<td>City as Classroom</td>
<td>3</td>
</tr>
<tr>
<td>POSC 322</td>
<td>Political Movements and Political Participation</td>
<td>3</td>
</tr>
<tr>
<td>POSC 346/446</td>
<td>Women and Politics</td>
<td>3</td>
</tr>
<tr>
<td>SASS 369</td>
<td>Social Networking and Community Organizing in the 21st Century</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 380</td>
<td>Social Movements and Social Change</td>
<td>3</td>
</tr>
<tr>
<td>SPAN 315</td>
<td>Latin American Cultural Conflicts</td>
<td>3</td>
</tr>
</tbody>
</table>

**Academic Program Faculty**

Timothy Black, PhD
Associate Professor, Department of Sociology

John H. Flores, PhD
SJ Academic Coordinator; Associate Professor, Department of History

B. Jessie Hill, JD
Judge Ben C. Green Professor of Law; Associate Dean for Academic Affairs, School of Law

Daniel J. Lacks, PhD
C. Benson Branch Professor, Department of Chemical and Biomolecular Engineering, School of Engineering

Sana Loue, PhD, JD
Professor, Department of Bioethics; Vice Dean for Faculty Development and Diversity, School of Medicine

Marilyn Sanders Mobley, PhD
Professor, Department of English; Vice President for Inclusion, Diversity & Equal Opportunity

Diana L. Morris, PhD, RN, FAAN, FGSA
Florence Cellar Associate Professor of Gerontological Nursing, Frances Payne Bolton School of Nursing; Executive Director, University Center on Aging & Health

Camille B. Warner, PhD
Assistant Professor of Nursing, Frances Payne Bolton School of Nursing

Ruqaiijah A. Yearby, JD, MPH
Associate Dean of Institutional Diversity and Inclusiveness, David L. Brennan Professor, School of Law
Courses

SJUS 100. Introduction to Social Justice. 3 Units.
Concepts of and quests for justice, and struggles against injustice, have shaped human understanding, relationships, and behavior for centuries. Individuals operate within community contexts created through interactions and relationships structured by sociability, belonging, and responsibility. Probing broad questions, this signature core course will encourage students to think critically and expansively about the social world and the conditions of humanity. The course will provide a foundational exploration of social justice concepts, issues, and remedies, thereby developing the necessary analytical tools and information to assess inequality and injustice and address historical and contemporary issues. Following an interdisciplinary, case-study approach, featuring faculty from different schools and departments at CWRU, this course also will provide students with multiple frameworks for understanding the interconnections between what are often perceived as disparate and disconnected fields of study and inquiry. Three primary questions guide the course: What is social justice? Why does social justice matter? What can be done? Counts for CAS Global & Cultural Diversity Requirement.

SJUS 200. Social Justice Engagement Seminar: Experiential, Community Based Learning. 1 Unit.
SJUS Engagement Seminar: Experiential, Community Based Learning. This one-credit seminar is designed to provide real life engagement with the community, and to facilitate student interaction with themes and topics related to Social Justice. Students will attend a set number of out-of-classroom events on campus and in the community to learn from community members, workers and leaders who are actively experiencing, educating about, and addressing social justice issues. Engagement in the community and with diverse stakeholders is necessary to developing awareness and sensitivity to the context and forms of justice and injustice within socio-political constructs. Further direct engagement is necessary to begin to synthesize and integrate the knowledge and skills necessary to develop oneself as an active agent for change and responsible citizen. Therefore, and emphasis will be placed on observing and analyzing the efficacy of strategies for individual resistance and social action. Prereq: SJUS 100.

SJUS 398. Social Justice Capstone Project. 3 Units.
In this course, students will identify and develop a project that addresses a relevant justice issue. Students will apply knowledge from historical and theoretical justice frameworks, and emphasis is placed on critical analysis of the issue. Students will have the opportunity to engage with stakeholders in a community based immersion experience in local, national or international settings. This culmination course is designed to provide students with an opportunity to demonstrate foundational skills facilitating social change from diverse community, academic, and professional perspectives. Finally, students will work to select and perhaps implement remedies such as individual resistance, policy, advocacy and social action, and collective struggle to address the respective injustice. Prereq: SJUS 100.

The Department of Sociology offers programs leading to the Bachelor of Arts, Master of Arts, and Doctor of Philosophy degrees.

Sociologists investigate basic social processes and social change in an increasingly complex world. Sociological research addresses important and often fascinating questions about the social world, ranging from the micro level of everyday experience to the macro level of entire societies and cross-societal analyses. Our graduate program reflects the research strengths of our faculty, and includes specializations in Sociology of Health and Medicine, Sociology of Age and the Life Course, Social Inequalities, and Research Methods. Our undergraduate program offers concentrations in Crime, Law and Justice; Gender, Work and Family; Health, Medicine and Aging; and Social Inequality.

Many sociology majors participate in field-based learning experiences, both through their classes and through their involvement in faculty research projects. The Department of Sociology encourages interaction between students and faculty by offering many opportunities for individualized study and research. Our department has a long history of combining academic excellence and leadership in research with a friendly, student-centered culture, for both graduate and undergraduate students.

Especially with globalization and the increasing diversity of our society, many employers look favorably on the breadth of knowledge and perspective provided by majoring in sociology. Our program prepares students for rigorous graduate and professional programs, whether in sociology or in such fields as medicine, law, public health, and social work, as well as for interesting jobs. Graduates of our program are working in positions in research institutions, medicine, private industry, and the public sector.

Undergraduate Programs

In addition to the Sociology major, the undergraduate program also offers a Sociology minor option and an IGS (Integrated Graduate Studies) Program that enables students to complete BA and MA degrees simultaneously. Sociology offers a general curriculum, and students may also elect to specialize in one of four concentrations described in detail below (Crime, Law and Justice; Gender, Work and Family; Health, Medicine and Aging; and Social Inequality).

Major

The major in sociology has been designed to serve the different educational goals of undergraduates: general education, pre-professional training, postgraduate employment, and preparation for graduate school. The major requires a minimum of 30 hours of course work. All majors complete the common core requirements, plus electives:

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>SOCI 101</td>
<td>Introduction to Sociology</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 300</td>
<td>Modern Sociological Thought</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 303</td>
<td>Social Research Methods</td>
<td>3</td>
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<tr>
<td>PSCL 282</td>
<td>Quantitative Methods in Psychology</td>
<td>3</td>
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<td>or</td>
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<tr>
<td>STAT 201</td>
<td>Basic Statistics for Social and Life Sciences</td>
<td>3</td>
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</table>

An additional 18 hours of electives, consisting of any six courses in sociology are required.

Total Units 33
SOCI 375 Independent Study is available to selected majors in their junior or senior year.

Majors have the option of choosing a general sociology curriculum or one of four concentrations:

1. Crime, Law and Justice
2. Gender, Work and Family
3. Health, Medicine and Aging
4. Social Inequality

Students may choose four courses within any of the following specializations for a concentration in that area:

### Crime, Law and Justice Concentration

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>SOCI 204</td>
<td>Criminology</td>
</tr>
<tr>
<td>SOCI 250</td>
<td>Law &amp; Society: Law, Rights and Policy</td>
</tr>
<tr>
<td>SOCI 320</td>
<td>Delinquency and Juvenile Justice</td>
</tr>
<tr>
<td>SOCI 333</td>
<td>Sociology of Deviant Behavior</td>
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<tr>
<td>SOCI 349</td>
<td>Social Inequality</td>
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<tr>
<td>SOCI 360</td>
<td>The Sociology of Law</td>
</tr>
<tr>
<td>SOCI 366</td>
<td>Racial Inequality and Mass Imprisonment in the US</td>
</tr>
<tr>
<td>SOCI 374</td>
<td>Using Law to Designate Public-Private Boundaries for Social Policies</td>
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### Gender, Work, and Family Concentration

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>SOCI 201</td>
<td>Introduction to Gender Studies</td>
</tr>
<tr>
<td>SOCI 208</td>
<td>Dating, Marriage, and Family</td>
</tr>
<tr>
<td>SOCI 228</td>
<td>Sociology of Sexuality</td>
</tr>
<tr>
<td>SOCI 275</td>
<td>Lives in Medicine: Becoming and Being a Physician</td>
</tr>
<tr>
<td>SOCI 326</td>
<td>Gender, Inequality, and Globalization</td>
</tr>
<tr>
<td>SOCI 356</td>
<td>Economic Sociology: Money, Markets, Morals, and Social Life</td>
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<tr>
<td>SOCI 370</td>
<td>Sociology of the Family</td>
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<tr>
<td>SOCI 372</td>
<td>Work and Family: U.S. and Abroad</td>
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### Health, Medicine and Aging Concentration

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<tr>
<th>Course Code</th>
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<tr>
<td>SOCI 203</td>
<td>Human Development: Medical and Social</td>
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<tr>
<td>SOCI 264</td>
<td>Body, Culture and Disability</td>
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<tr>
<td>SOCI 275</td>
<td>Lives in Medicine: Becoming and Being a Physician</td>
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<tr>
<td>SOCI 311</td>
<td>Health, Illness, and Social Behavior</td>
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<td>SOCI 313</td>
<td>Sociology of Stress and Coping</td>
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<td>SOCI 319</td>
<td>Sociology of Institutional Care</td>
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<td>SOCI 344</td>
<td>Health Disparities</td>
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<td>SOCI 345</td>
<td>Sociology of Mental Illness</td>
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<td>SOCI 361</td>
<td>The Life Course</td>
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<td>SOCI 365</td>
<td>Health Care Delivery</td>
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<td>SOCI 369</td>
<td>Aging in American Society</td>
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<td>SOCI 377</td>
<td>Population Dynamics and Changing Societies</td>
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### Social Inequality Concentration

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<th>Course Code</th>
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<tr>
<td>SOCI 113</td>
<td>Critical Problems in Modern Society</td>
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<tr>
<td>SOCI 201</td>
<td>Introduction to Gender Studies</td>
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<tr>
<td>SOCI 202</td>
<td>Race and Ethnic Minorities in The United States</td>
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<tr>
<td>SOCI 203</td>
<td>Human Development: Medical and Social</td>
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<td>SOCI 228</td>
<td>Sociology of Sexuality</td>
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<tr>
<td>SOCI 320</td>
<td>Delinquency and Juvenile Justice</td>
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<td>SOCI 326</td>
<td>Gender, Inequality, and Globalization</td>
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<td>SOCI 328</td>
<td>Urban Sociology</td>
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<td>SOCI 344</td>
<td>Health Disparities</td>
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<td>SOCI 347</td>
<td>Sociology of Education</td>
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<tr>
<td>SOCI 349</td>
<td>Social Inequality</td>
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<tr>
<td>SOCI 356</td>
<td>Economic Sociology: Money, Markets, Morals, and Social Life</td>
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<tr>
<td>SOCI 366</td>
<td>Racial Inequality and Mass Imprisonment in the US</td>
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<tr>
<td>SOCI 372</td>
<td>Work and Family: U.S. and Abroad</td>
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<tr>
<td>SOCI 374</td>
<td>Using Law to Designate Public-Private Boundaries for Social Policies</td>
</tr>
<tr>
<td>SOCI 380</td>
<td>Social Movements and Social Change</td>
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### SAGES Participation

In conjunction with the SAGES program, the department offers two special seminars, SOCI 325 Departmental Seminar in Sociology: Great Books and SOCI 392 Senior Capstone Experience. These seminars fulfill SAGES requirements but are NOT requirements for the major. They may, however, be counted toward the 30 hours for the sociology major or the 15 hours for the minor.

### Departmental Honors

Juniors majoring in sociology with a 3.4 overall GPA and a 3.6 GPA in sociology are invited to apply for the department's honors program, which consists of an intensive, year-long investigation of a research problem under the guidance of a faculty member. Students will earn credit through registration in SOCI 397 Honors Studies and SOCI 398 Honors Studies. Admission to honors work is by faculty approval.

The opportunity to join Alpha Kappa Delta (AKD), the national sociology honors fraternity, is available to junior or senior sociology majors. Membership requires a 3.0 GPA in sociology and a 3.3 GPA overall. In addition, the student must have completed at least four sociology courses.

### Integrated Graduate Studies

The Department of Sociology participates in the Integrated Graduate Studies Program (p. 1078). Students in the program are able to obtain BA and MA degrees simultaneously. Interested students should note the general requirements and the admission procedures in the appropriate section of this bulletin and may consult the department for further information.

### Minor

The minor consists of 15 credit hours in sociology, including:

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<tr>
<td>SOCI 101</td>
<td>Introduction to Sociology</td>
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Graduate Programs

The Department of Sociology offers graduate training leading to the Doctor of Philosophy degree. Students may petition for a Master of Arts degree once they fulfill the requirements outlined below. Sociology of Age and the Life Course, Medical Sociology, Social Inequality, and Research Methods are the major areas of emphasis in the department.

Master of Arts

To receive the Master of Arts degree, a student must successfully complete 27 credit hours of course work.

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<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tr>
<td>SOCI 400</td>
<td>Development of Sociological Theory</td>
<td>3</td>
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<tr>
<td>SOCI 406</td>
<td>Logic of Social Inquiry</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 443</td>
<td>Medical Sociology</td>
<td>3</td>
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<tr>
<td>SOCI 449</td>
<td>Social Inequality</td>
<td>3</td>
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<tr>
<td>SOCI 469</td>
<td>Aging in American Society</td>
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One of the following:

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<tbody>
<tr>
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<td>Contemporary Sociological Theory</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 407</td>
<td>Social Statistics</td>
<td>3</td>
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</table>

Three general electives in sociology

Total Units 27

In addition, the student must pass one written comprehensive examination in Sociology of Age and the Life Course, Medical Sociology, Social Inequality, or Research Methods.

Doctor of Philosophy

The Doctor of Philosophy degree is awarded upon the completion of all requirements of the School of Graduate Studies and the following departmental requirements.

1. Completion of 63 credit hours beyond the Bachelor of Arts degree, including 18 credits of SOCI 701 Dissertation Ph.D. (dissertation hours).

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<td>SOCI 469</td>
<td>Aging in American Society</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 509</td>
<td>Advanced Statistical Analysis</td>
<td>3</td>
</tr>
<tr>
<td>SOCI 514</td>
<td>Qualitative Methods/Field Research</td>
<td>3</td>
</tr>
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Four electives (2 each) in age and the life course, medical sociology, social inequality, or research methods

Two general electives in sociology

18 credit hours of dissertation

Total Units 63

2. In addition, the student must pass written comprehensive examinations in two of the four areas (Sociology of Age and the Life Course, Medical Sociology, Social Inequality, Research Methods) and successfully defend the dissertation.

Research Programs

Cancer Survivors Research Program

The Cancer Survivors Research Program (CSRP) investigates the quality of life of older adults who face the dual vulnerability of aging and the long term effects of having survived cancer. The research also focuses on health disparities and psycho-social factors related to race and gender. Formally started in September 1998, the program of research has benefited from extramural funding through a number of NIH (NCI/NIA) research grants. Gary Deimling serves as program director and is assisted by colleagues in the Department of Sociology and the CWRU School of Medicine. As with many other research programs within the department and the university at large, the CSRP also serves as a teaching facility, training graduate students in the many methodological and theoretical aspects of socio-medical research. The program enables graduate students in sociology to gain hands-on experience in a formal research setting while putting their course work into practice.

Citizen Reentry Study

This three-year research project identifies men, mostly fathers, who are locked up in an alternative incarceration facility in Cleveland, Ohio for no more than six months. We observe programs in the facility and run a study circles group, and then track men for six months after their release into the community. The study focuses on the ways that men are prepared for reentry, identifies the systemic barriers to reentry, examines how men negotiate the conditions and processes of reentry, and describes varying outcomes.

Comparative-Historical Analysis of Children's Rights

The Children’s Rights Index (CRI), developed by Brian Gran, is an innovative measure of the status of children’s rights in more than 190 countries for 2004. With funding from the National Science Foundation, this project is now replicating the CRI for five-year intervals during the period 1984 to 2014.

Past studies of children’s rights have focused on violations of particular rights, and on specific countries where children’s rights are frequently or severely violated. What has been lacking is systematic scholarship on the various kinds of children’s rights that exist, across countries and over time. This project examines factors that promote or hinder children’s rights. A short-term objective is to provide evidence on the status of children’s rights. A long-term objective is to use the CRI to determine whether stronger rights lead to superior outcomes for children.

Cumulative Dis/Advantage Research Group: Health Disparities and Trajectories of Inequality Across the Life Course

Across societies, inequalities among age peers in health, well-being and resources exist throughout the life course, and tend to increase with age in each succeeding cohort of individuals. How does such intracohort inequality come about? What are its manifestations and consequences? The Cumulative Dis/Advantage (CDA) Research Group analyzes the social processes that create inequalities across multiple dimensions of well-being and health, including physical function, mental health, and longevity. The group also examines social policies that are intended to ameliorate these inequalities, such as Medicare. Jessica Kelley-Moore examines health disparities, and especially the influence of social and economic circumstances over the life course on later-life health, with a focus on differences organized by race/ethnicity and disability. Dale Dannefer is interested in identifying basic sociological processes that...
contribute to CDA and understanding their interrelation at macro-, meso-, and micro-levels of analysis.

**The Elderly Care Research Center**
The Elderly Care Research Center (ECRC) conducts research projects focusing on theory-based and public policy-relevant issues in aging and medical sociology. Current projects relate to physical and mental health outcomes of stress, coping, cancer survivorship, and adaptation to frailty in late life. Research projects have been funded by the National Institute on Aging (NIA), the National Cancer Institute (NCI), and the National Institute of Nursing Research. In addition to conducting quantitative surveys and in-depth qualitative interviews with community-dwelling elders, researchers at the ECRC are also engaged in an NCI-funded intervention to help elderly patients communicate more effectively with their doctors.

The Center has been the recipient of an NIA Merit Award for a long-term study of very old residents of a retirement community. This research seeks to understand health promotion, proactive adaptation, and maintenance of wellness in late life. ECRC serves as a laboratory for student research. Collaborative and cross-national research involves colleagues from multiple disciplines at universities in Israel, Hungary, Britain, and Germany.

**The Forest Hill Neighborhood Study**
The Forest Hill Neighborhood Study aims to unpack the causes of racial residential preferences by examining what compels members of the middle class to live in a majority-black neighborhood. Research consistently demonstrates that non-blacks consider predominantly black neighborhoods to be the least desirable of all possible neighborhoods. This project focuses on the residents of the Forest Hill neighborhood of East Cleveland, with the goal of identifying the characteristics and features of majority-black neighborhoods that middle-class blacks and non-blacks find desirable. The study investigates how cultural and racial dispositions factor into participants’ selection of a neighborhood. The study also compares the experiences of white residents to those of black residents and examines the history of the neighborhood, which, for most of its existence, excluded black homeowners.

**Learning from Those Who Know: Action Research and Reform Efforts in Long-Term Care**
This project responds to the need to reform and restructure long-term care by incorporating the perspectives, insights, and expertise of those whom such reforms are intended to serve, yet who often have little voice in the reform process: the residents themselves. Using the method of participatory action research, the project assembles research groups consisting of residents, staff, family members, and researchers who meet weekly to discuss life in the facility and to identify areas where change could benefit those who live (or work) there.

**The Solidarity Refugee Oral History Project**
This study is recording the oral histories of members of the Solidarity trade union in Poland (Niezależny Samorządzny Związek Zawodowy „Solidarność”) who received refugee or asylee status in the United States in the 1980s. The oral histories document their experiences in communist Poland as children, involvement in Solidarity, decision to emigrate, political activities and occupations in the U.S., and decision to return to Poland or not post-1989. This study analyzes the extent to which economic and political factors are intertwined in decisions to emigrate (and return to the homeland) as well as how normative life transitions are shaped by social movements and migration.

**Department Faculty**

- Dale Dannefer, PhD (Rutgers University)
  - *Selah Chamberlain Professor of Sociology and Chair*
  - Aging and the life course; theory; work and family; research methods

- Timothy Black, PhD (University of Massachusetts-Amherst)
  - *Associate Professor*
  - Social inequality; poverty; urban sociology; qualitative research methods

- Gary Deimling, PhD (Bowling Green State University)
  - *Professor*
  - Medical sociology; sociology of aging; family sociology

- Mary Patrice Erdmans, PhD (Northwestern University)
  - *Associate Professor*
  - Social inequality; race and ethnicity; immigration; qualitative research methods; gender

- Brian Gran, PhD, JD (Northwestern University; Indiana University-Bloomington)
  - *Professor*
  - Sociology of law; comparative sociology; health care policy; human rights

- Susan W. Hinze, PhD (Vanderbilt University)
  - *Associate Professor*
  - Medical sociology; social inequality, sex and gender; work and family

- Eva Kahana, PhD (University of Chicago)
  - *Distinguished University Professor and Pierce T. and Elizabeth D. Robson Professor of the Humanities*
  - Sociology of aging; medical sociology; social factors in stress and coping

- Jessica Kelley-Moore, PhD (Purdue University)
  - *Associate Professor*
  - Health disparities; sociology of disability; sociology of the life course; race/ethnicity

- Cassi Pittman, PhD (Harvard University)
  - *Assistant Professor*
  - Race and ethnic relations; social stratification and inequality; sociology of consumption; economic sociology; qualitative methods

**Secondary Faculty**

- David E. Biegel, PhD (University of Maryland, Baltimore)
  - *Henry Zucker Professor, Jack, Joseph and Morton Mandel School of Applied Social Sciences*
  - Family; social networks; caregiving; mental health
Kurt Stange, MD, PhD
(University of North Carolina)
Professor, Department of Epidemiology and Biostatistics, School of Medicine
Epidemiology; preventive health care; biostatistics; disability prevention in the elderly

Adam T. Perzynski, PhD
(Case Western Reserve University)
Assistant Professor, School of Medicine
Sociology of health and illness; qualitative and quantitative methods; health disparities; health informatics

Aloen Townsend, PhD
(University of Michigan)
Professor, Jack, Joseph and Morton Mandel School of Applied Social Sciences
Adult development and aging; research methods and statistics; mental health; families and formal service systems

Adjunct Faculty
Gunhild Hagestad, PhD
(University of Minnesota)
Professor Emeritus of Sociology, Agder University College; Senior Researcher, NOVA (Norwegian Social Research)
Life course; gender; social policy

Edward H. Thompson, Jr., PhD
(Case Western Reserve University)
Professor Emeritus, College of the Holy Cross
Aging and masculinities; families and later life; men's health; religion and health

Lecturer
Karie Feldman, PhD
(Case Western Reserve University)
Lecturer
Family policy, medical sociology, sex and gender

Courses

SOCI 101. Introduction to Sociology. 3 Units.
This course examines the basic principles that underlie how sociologists look at the world: "The Sociological Imagination". It addresses the basic questions: How is social order possible and how does change occur? The course is designed as a foundation for further study in field of sociology and related disciplines. It introduces the student to the role that culture and social institutions play in modern society and examines important concepts such as socialization, deviance, social control, patterned inequalities and social change. These concepts are discussed in the context of both contemporary and historical social theories. Additionally, the student will be introduced to the methods of inquiry used by practicing sociologists.

SOCI 113. Critical Problems in Modern Society. 3 Units.
Focus is on major social problems present in large, complex, industrial societies. Topics include environmental problems, poverty, drug addiction, social deviance, and alienation.
SOCI 228. Sociology of Sexuality. 3 Units.
This course analyzes the issues of sex and sexuality from a sociological point of view. It is centered on the notion that what we consider to be "normal" or "natural" about sex and sexuality is, in reality, socially constructed. One's viewpoint on the issues surrounding sexuality are influenced by the social context in which they live, as opposed to the purely biological viewpoint that presupposes some sense of normalcy or naturalness regarding sexual relations. A range of topics will be covered, including readings that discuss the variations of sexuality and the notions of sexual "deviance" in order to explore the cultural and societal variation that exists along the lines of gender, race, ethnicity, sexual orientation, age and disability. Offered as SOCI 228 and WGST 228.

SOCI 250. Law & Society. Law, Rights and Policy. 3 Units.
How do rights, including human rights, fit in the legal system and society? We will ask how legal actors, like judges and lawyers, think about rights compared to non-lawyers. We will (try to!) observe court hearings in an Ohio Appellate Court and a local small claims court. We will closely examine legal institutions, such as correctional facilities. We will benefit from hearing experts, local, national, and international, discuss how "law" works and whether rights are useful to making change. We will hear from a law school professor on how law school works and what the practice of law is like.

SOCI 255. Special Topics. 1 - 3 Units.
Courses taught as special topics seminars focus on selected areas of study in sociology. They tend to be more specialized and emphasis is placed upon a sociological examination of one social institution (such as the media) or on one historical period (such as the '60s).

SOCI 264. Body, Culture and Disability. 3 Units.
This course examines the ways that the body is constructed through culture, media, and policy and how that, in turn, defines disability. Students will explore the socio-historical shifts in views and treatment of the body, as a way to understand how this is used to classify, marginalize and contain social differences. We trace these trends through the American Freak Show to present day Disability Determination Processes in the Social Security Administration. We further explore how historical perspectives of the body "carry forward" through social institutions such as health care, religion and education.

SOCI 275. Lives in Medicine: Becoming and Being a Physician. 3 Units.
This course applies a sociological approach to medical profession. Medical sociology emerged as a distinct field of study in the 1950s in part due to prominent studies of medical education such as The Student Physician by Robert K. Merton and Howard Becker's Boys in White. Since then, sociologists and other social scientists have written extensively about how issues of race, gender, aging and ethnicity are tied to issues of medical education, medical training, medical socialization and physician decision-making. Using a life course perspective, this course will examine how lives in medicine change over time; in particular, we'll study changing workforce patterns, physician satisfaction, and burnout. Other topics to be covered include contemporary ethical issues and alternative professional health careers. The course provides an overview of how medicine and medical practice have a profound influence on-and are influenced by--social, cultural, political and economic forces. In short, you'll become familiar with how scholars outside of medicine cast a sociological gaze on the profession.

SOCI 300. Modern Sociological Thought. 3 Units.
The most profound commentary of industrial society began in the middle of the nineteenth century with thinkers such as Durkheim, Marx, and Max Weber. Students will read the work of these scholars as it appeared in the original sources. They thoughtfully address concepts such as social integration and alienation, crime and punishment, and the social impact of modernization. The course is of special relevance to students in the social sciences, but is also recommended for students in other fields who wish to understand the social context in which professional lives will be conducted. Prereq: SOCI 101 and Sophomore standing.

SOCI 303. Social Research Methods. 3 Units.
Principles of making causal inferences about human behavior; problem formulation and research design; measurement of sociological concepts; data collection and analysis methods; evaluation of research findings. Prereq: SOCI 101 and Sophomore standing.

SOCI 310. The Individual in Society. 3 Units.
This course focuses on the relationship between individuals and the societies in which they live. Influences of values and culture on individuals' selves and identities are discussed as well as how individuals attach meaning to personal life experiences and histories in the context of society at large. Offered as SOCI 310 and SOCI 410. Prereq: SOCI 101.

SOCI 311. Health, Illness, and Social Behavior. 3 Units.
This course considers the role of social factors (e.g., poverty, occupational and family structure) on health and illness. Discussion will concentrate on the role of health promotion (e.g., anti-smoking campaigns), social behavior and lifestyle in health and health care use. Considerable attention is given to understanding health careers and professions and their role in the health of societies and individuals. Offered as SOCI 311 and SOCI 411. Prereq: SOCI 101 and Sophomore standing.

SOCI 313. Sociology of Stress and Coping. 3 Units.
This course will focus attention on human stress throughout the lifespan and its role in personal health and well-being. There have been exciting advances in recent years in understanding the nature of stress in everyday life as well as elements of extreme stress. Trauma is experienced by many people due to normative events such as illness and bereavement or natural and man-made disasters such as crime or war. Coping strategies and social supports which ameliorate negative impact of stress will be considered. Offered as SOCI 313 and SOCI 413. Prereq: SOCI 101 and Sophomore standing.

SOCI 315. Comparative-Historical Sociology. 3 Units.
This seminar offers participants an introduction to comparative methodological approaches to social science research. Participants will employ hands-on approaches to learning about and using innovative methods to apply their knowledge to social science questions. Our starting point will be key questions social scientists must contend with in pursuing answers to questions about social phenomena. After turning to "classic" texts in comparative research, we will study various components of comparative research. We will then focus on configurational comparative methods. Offered as SOCI 315 and SOCI 415. Prereq: SOCI 101 and Sophomore standing.

SOCI 319. Sociology of Institutional Care. 3 Units.
This course focuses on converging issues of theory, research, and practice in general hospitals, mental hospitals, nursing homes, hospices, and correctional institutions. The ecology of institutions and the adaptation of individuals within institutions will also be considered. There will be field trips to institutional facilities. Offered as SOCI 319 and SOCI 419. Prereq: SOCI 101 and Sophomore standing.
SOCI 320. Delinquency and Juvenile Justice. 3 Units.
The primary focus of this course is on acquainting the student with the nature and the extent of juvenile delinquency. Accordingly, theoretical approaches to delinquency causation and the prevention, control, and treatment of delinquent behavior in society are addressed. Important aspects of juvenile justice procedures, policy, and practice are examined, and the early history of the juvenile justice system and the many changes occurring over the years are discussed. Prereq: SOCI 101.

SOCI 325. Departmental Seminar in Sociology: Great Books. 3 Units.
This course fulfills the SAGES requirement of a Departmental Seminar. It focuses on close readings of contemporary classics in sociology, analytical writing and intensive seminar-type discussion. The course examines theoretical perspectives and methodological issues in sociology such that students are able to investigate, analyze and present research findings in written form. Research is always an inherently collaborative process and thus the course will utilize seminar-style discussions to formulate and examine ideas. The seminar will focus on topics germane to a critical reading of books that inform our understanding of large and small group processes as well as individual experiences. Students will be introduced to the sociological imagination as an overarching frame work to examine groundbreaking classical and contemporary books on topics such as health and aging, gender, work and family, social inequality and crime and delinquency, guided by the instructor of record. Readings will provide a sociological perspective for understanding and assessing macro- and micro-level interactions as well as encourage and stimulate critical thinking. Counts as SAGES Departmental Seminar.

SOCI 326. Gender, Inequality, and Globalization. 3 Units.
Using a sociological perspective, this course examines how major societal institutions, including the economy, polity, medicine, religion, education and family, are structured to reproduce gendered inequalities across the globe. Attention is given to the intersections of race/ethnicity, social class, gender and sexuality in social systems of power and privilege. Of critical importance is how gender figures in the relationship between Economic North and Economic South countries. We will elucidate how gender norms vary by culture and exert profound influence on the daily, lived experiences of women and men. The course will be informed by recent scholarship on feminism, women’s movements, and globalization. Offered as SOCI 326 and WGST 326. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SOCI 101 or permission of program director.

This course discusses theoretical foundations and methodologies of narrative research, including life stories, oral history, and auto ethnography. The course is designed for students to complete a research project in the semester using narrative methods to collect and analyze primary data and write up the results. Offered as SOCI 327 and SOCI 427. Prereq: SOCI 101 and SOCI 303.

SOCI 328. Urban Sociology. 3 Units.
The goal of this course is to acquaint the student with the realities and the possibilities of our urban society. Theories and applications of urban sociology interpreting city life and structure are reviewed. The transformation of the urban landscape, the emergence of cities, urban life, urban problems, and urban planning are explored. Issues related to finances, schooling, transportation, the infrastructure of the city, growth and decline, urban poverty, the homeless, crime, pollution, as well as the policy issues and questions such concerns provoke are studied. Key aspects of social science theories and research findings about the nature of spatial, economic and social relationships in cities in developed and developing countries will be analyzed, illuminating some of the processes of urban growth, social transition, and change. Offered as SOCI 328 and SOCI 428. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SOCI 101.

SOCI 333. Sociology of Deviant Behavior. 3 Units.
Sociological approaches to causes of deviant behavior, and social psychology of deviance are studied. Illustrations range from juvenile delinquency to scientific misconduct and cover both criminal and noncriminal forms of deviance. Prereq: SOCI 101.

SOCI 338. Seminar and Practicum in Adolescents. 3 Units.
Supervised field placement and attendance in early childhood, child, and adolescent settings including preschools, schools, hospitals, and neighborhood centers. This class is used to fulfill requirements by the Ohio Department of Education teacher licensure program. Recommended preparation: PSCL 101, EDUC 301, EDUC 304, and permission of program director. Offered as EDUC 338, PSCL 338, and SOCI 338.

SOCI 344. Health Disparities. 3 Units.
We have come to understand that stark disparities in health result from the social organization of society, especially inequality in resources and opportunities between and within social groups in the population. This seminar course examines the differential distribution of health and illness in society, focusing on the social determinants of health. Topics include: socioeconomic inequality; geographic context; social cohesion and exclusion; health burden in minority populations; policy and federal priorities. We utilize a life course perspective to understand how inequality “gets under the skin” to produce adverse health. Offered as SOCI 344 and SOCI 444. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SOCI 101 and Sophomore standing.

SOCI 345. Sociology of Mental Illness. 3 Units.
Focus is on social construction of mental health and illness and sociology of emotions. Social determinants of psychological distress will be discussed along with social stigma associated with mental illness. Institutional and community options for care of the mentally ill will be considered along with the impact of recent social movements of deinstitutionalization and independent living. Offered as SOCI 345 and SOCI 445. Prereq: SOCI 101 and junior/senior standing.

SOCI 347. Sociology of Education. 3 Units.
This course provides an introduction to the field of sociology of education, which might be more properly called sociology of schooling. We will examine the development of schools historically and competing paradigms for understanding the place of school in society. Major theoretical perspectives concerning the nature and consequences of schools for individuals and for societies will be reviewed. Issues of individual opportunity - including how it is organized by race, class, and gender - will be covered, as well as issues institutional dynamics - including tracking, testing and so-called crisis and reform. Offered as SOCI 347 and SOCI 447. Prereq: SOCI 101 and junior or senior standing.
SOCI 349. Social Inequality. 3 Units.
This course discusses classical theory and contemporary research on the mechanisms of power that produce inequalities in income, wealth, education, privilege, and occupational prestige and are manifest in racial, ethnic, gender, age, health, and sexual hierarchies. Offered as SOCI 349 and SOCI 449. Prereq: SOCI 101 and Sophomore standing.

SOCI 355. Special Topics. 3 Units.
One or more sections each semester focusing on selected areas of study in sociology. Offered as SOCI 355 and SOCI 455.

SOCI 356. Economic Sociology: Money, Markets, Morals, and Social Life. 3 Units.
The course introduces students to a sociological perspective on the economy, and the social processes that effect and are embedded in economic behavior, economic institutions and markets. Students will examine issues such as the social significance of money, the effect of social networks on labor market outcomes, the success and failure of firms, tips and gifts, informal markets and the trade of illicit goods, as well as topics such as immigration and globalization. Our investigations into these diverse topics reveal how economic phenomena, economic systems and processes are shaped by social networks, cultural understandings and relations of power. Throughout the course students will examine how economic relations are facilitated–created, maintained, transformed, and constrained–by social relations, revealing that economic life and behavior is just as social as religion, family or education. Prereq: SOCI 101.

SOCI 360. The Sociology of Law. 3 Units.
This course will focus on the role of rights in the U.S. legal system and society. In particular, we will consider three questions. The first is how do rights fit in the legal system and society? Second, how have different social groups used and thought about rights? Third, how do legal actors like judges and lawyers think about rights compared to non-lawyers? Offered as SOCI 360 and SOCI 460. Prereq: SOCI 101 and Sophomore standing.

SOCI 361. The Life Course. 3 Units.
Individual experiences and transitions over the life course are considered as the result of societal, cultural, psychological, biological, and historical influences. Developmental issues of childhood, adolescence, young adulthood, middle years and late life are discussed in the context of social expectations, challenges, and opportunities. Emphasis is placed on theoretical readings. Offered as SOCI 361 and SOCI 461. Prereq: SOCI 101 and Sophomore standing.

SOCI 364. Disability and Society. 3 Units.
This course considers and examines the relationship between disability and society. The course covers how we define, represent, and react to disability in modern society. This includes an analysis of stigma and discrimination. We also explore the timing and experience of disability from a life-course perspective. Finally, we examine the political, social, and economic influences on disability, including the Disability Rights movement. Offered as SOCI 364 and SOCI 464. Prereq: SOCI 101 and sophomore standing.

SOCI 365. Health Care Delivery. 3 Units.
Health care in the U.S. may be approaching a critical cross-road. Limiting care to older persons and the chronically ill has been proposed as a means to combat rising costs and limited access to health care. What are the alternatives to health care rationing? Socialized medicine? National health insurance? This course deals with issues of cost, quality, and access to health care in the United States and other societies. It considers how solutions by other societies can provide directions for the organization of health care in the U.S. Offered as SOCI 365 and SOCI 465. Prereq: SOCI 101 and Sophomore standing.

SOCI 366. Racial Inequality and Mass Imprisonment in the US. 3 Units.
This course examines the relationship between racial inequality and mass imprisonment in the U.S. It begins by exploring the role of prisons in the Jim Crow south, with a particular focus on convict-leasing practices, and then turns to the north to examine the social forces that created the black urban ghetto and concentrated black urban poverty. The course also examines the impact that these same social forces have had on Puerto Ricans. We will then explore a series of topics including urban poverty and crime, the war on drugs, the politics of mass incarceration, the prospects that mass incarceration has become the new Jim Crow, and the effects that mass incarceration has had on voting rights, urban communities, families and children. We will conclude with a discussion of varying decarceration arguments, strategies, movements, and achievements. Prereq: SOCI 101 or SJUS 100.

SOCI 369. Aging in American Society. 3 Units.
Considers the position and participation of aged adults in American society. Sociological perspectives through which to interpret the aging process and old age; social policies; intergenerational relations; lifestyles and how they affect participation of the aged in American society; dying and death serve as major themes. Offered as SOCI 369 and SOCI 469. Prereq: SOCI 101 and Sophomore standing.

SOCI 370. Sociology of the Family. 3 Units.
This course provides the theoretical and methodological foundation for conducting family research. It also reviews the most current research in the sociology of the family arena such as intergenerational issues, ethnicity and gender, and family transitions. Offered as SOCI 370 and SOCI 470. Prereq: SOCI 101 and Sophomore standing.

SOCI 372. Work and Family. U.S. and Abroad. 3 Units.
Covers the impact on human lives of the interface between work and family; the different ways gender structures the experience of work and family depending upon racial and ethnic background, social class, age, and partner preference; the impact of historical context on work-family experiences; work-family policies in the United States and other countries. Offered as SOCI 372, WGST 372, and SOCI 472. Prereq: SOCI 101 and Sophomore standing.

SOCI 374. Using Law to Designate Public-Private Boundaries for Social Policies. 3 Units.
This course studies law and the public-private dichotomy. With a basis in important research on the sociology of law, it considers three questions: 1) What is the impact of "law" on the boundary separating the public and private sectors? 2) How does "law" designate which actors and institutions belong to the public and private sectors? 3) Is the public-private dichotomy adequate for sociological analyses of law and its influences? If not, what alternatives to the public-private dichotomy can we offer? Offered as SOCI 374 and SOCI 474. Prereq: SOCI 101.

SOCI 375. Independent Study. 1 - 3 Units.
Prereq: SOCI 101 and SOCI 300.
SOCI 377. Population Dynamics and Changing Societies. 3 Units.
Population and social structure are inextricably linked, as changes in one elicit changes in the other. Social demography, as a discipline, examines these linkages through the systematic study of the size, composition and distribution of populations and their relationship to the social, political and economic organization of societies. This course will pay particular attention to mortality, morbidity and health, fertility, family and household organization, and migration as the major processes of population change. The population dynamics of the United States will be emphasized, with select comparisons to developing and developed countries. Offered as SOCI 377 and SOCI 477. Prereq: SOCI 101 or equivalent; 9 hours in SOCI, ANTH, or ECON.

SOCI 380. Social Movements and Social Change. 3 Units.
This course will introduce students to the theories of social movements and collective action. We look at the conditions that create grievances in democracies, how grievances get translated into collective action, and what types of collective actions are successful for bringing about social change. We discuss a variety of movements in the U.S. in the 20th century to illustrate these theories and concepts. Prereq: SOCI 101 or requisites not met permission.

SOCI 381. City as Classroom. 3 Units.
In this course, the city is the classroom. We will engage with the urban terrain. We will meet weekly off-campus, interact with community members, and interface—both literally and figuratively—with the city as a way to examine the linkages between historical, conceptual, and contemporary issues, with particular attention paid to race and class dynamics, inequality, and social justice. This course will have four intersecting components, primarily focusing on American cities since the 1930s: the social and physical construction of urban space, the built environment, life and culture in the city, and social movements and grassroots struggles. Offered as HSTY 381, POSC 381, SOCI 381, HSTY 481, POSC 481, and SOCI 481. Counts for CAS Global & Cultural Diversity Requirement.

SOCI 392. Senior Capstone Experience. 3 Units.
SOCI 392 represents the completion of an independent study paper involving exploration of a sociology topic to be chosen in consultation with the student’s capstone advisor. The student will interact regularly with the faculty advisor who will review their progress on the project. This project allows for original thought and for the tailoring of the research to the student's interests. The student will integrate theory, methods and social issues as he/she applies critical thinking skills and insights to the analysis of some aspects of a subject chosen from any of the following subfields and concentrations: Gerontology, Social Inequality, Medical Sociology, Crime and Delinquency, The Life Course, Education, Work and Family, Sociology of Law, and Deviance. The Capstone Project has both a written and an oral component. Following the submission of the Capstone paper, the student will give a presentation of the project at the Senior Capstone fair, or another forum chosen by the department. Counts as SAGES Senior Capstone. Prereq: SOCI 101, SOCI 300, SOCI 303, and STAT 201 or PSCL 282.

SOCI 397. Honors Studies. 3 Units.
Intensive investigation of research or conceptual problem; original work under supervision of faculty member. Limited to senior majors. Prereq: Senior status.

SOCI 398. Honors Studies. 3 Units.
Intensive investigation of research on conceptual problem; original work under supervision of faculty member. Limited to senior majors.

SOCI 400. Development of Sociological Theory. 3 Units.
This course examines in detail the works of the major social theorists of the 19th and 20th centuries. It is intended to integrate their ideas with the social and historical milieu from which they were born. Questions of intergroup conflict vs. cooperation, interactions between economic, familial, religious, and political institutions, and the development of the self as a function of larger social processes are addressed. Such celebrated figures as Marx, Weber, and Durkheim, as well as modern thinkers will be presented and discussed. Prereq: Graduate standing.

SOCI 401. Contemporary Sociological Theory. 3 Units.
Current viewpoints in sociological theory are explored using contrasting theoretical perspectives.

SOCI 406. Logic of Social Inquiry. 3 Units.
The first of a two-semester series in social research methodology. Students will learn how to interpret and conduct social science research. The two-semester course covers problem formulation, the logic of causal inference, measurement models, research designs, sampling, data collection, and data analysis.

SOCI 407. Social Statistics. 3 Units.
The second of a two-semester series in social research methodology. (See SOCI 406.) Prereq: SOCI 406.

SOCI 410. The Individual in Society. 3 Units.
This course focuses on the relationship between individuals and the societies in which they live. Influences of values and culture on individuals' selves and identities are discussed as well as how individuals attach meaning to personal life experiences and histories in the context of society at large. Offered as SOCI 310 and SOCI 410.

SOCI 411. Health, Illness, and Social Behavior. 3 Units.
This course considers the role of social factors (e.g., poverty, occupational and family structure) on health and illness. Discussion will concentrate on the role of health promotion (e.g., anti-smoking campaigns), social behavior and lifestyle in health and health care use. Considerable attention is given to understanding health careers and professions and their role in the health of societies and individuals. Offered as SOCI 311 and SOCI 411.

SOCI 413. Sociology of Stress and Coping. 3 Units.
This course will focus attention on human stress throughout the lifespan and its role in personal health and well-being. There have been exciting advances in recent years in understanding the nature of stress in everyday life as well as elements of extreme stress. Trauma is experienced by many people due to normative events such as illness and bereavement or natural and man-made disasters such as crime or war. Coping strategies and social supports which ameliorate negative impact of stress will be considered. Offered as SOCI 313 and SOCI 413.

SOCI 415. Comparative-Historical Sociology. 3 Units.
This seminar offers participants an introduction to comparative methodological approaches to social science research. Participants will employ hands-on approaches to learning about and using innovative methods to apply their knowledge to social science questions. Our starting point will be key questions social scientists must contend with in pursuing answers to questions about social phenomena. After turning to "classic" texts in comparative research, we will study various components of comparative research. We will then focus on configurational comparative methods. Offered as SOCI 315 and SOCI 415.
SOCI 419. Sociology of Institutional Care. 3 Units.
This course focuses on converging issues of theory, research, and practice in general hospitals, mental hospitals, nursing homes, hospices, and correctional institutions. The ecology of institutions and the adaptation of individuals within institutions will also be considered. There will be field trips to institutional facilities. Offered as SOCI 319 and SOCI 419.

This course discusses theoretical foundations and methodologies of narrative research, including life stories, oral history, and auto ethnography. The course is designed for students to complete a research project in the semester using narrative methods to collect and analyze primary data and write up the results. Offered as SOCI 327 and SOCI 427.

SOCI 428. Urban Sociology. 3 Units.
The goal of this course is to acquaint the student with the realities and the possibilities of our urban society. Theories and applications of urban sociology interpreting city life and structure are reviewed. The transformation of the urban landscape, the emergence of cities, urban life, urban problems, and urban planning are explored. Issues related to finances, schooling, transportation, the infrastructure of the city, growth and decline, urban poverty, the homeless, crime, pollution, as well as the policy issues and questions such concerns provoke are studied. Key aspects of social science theories and research findings about the nature of spatial, economic and social relationships in cities in developed and developing countries will be analyzed, illuminating some of the processes of urban growth, social transition, and change. Offered as SOCI 328 and SOCI 428. Counts for CAS Global & Cultural Diversity Requirement.

SOCI 443. Medical Sociology. 3 Units.
Course covers theories, research methods, and problems in sociology of medicine. Topics include social epidemiology, health and illness behavior, and sick role. Structures and functions of delivery systems and their interrelationships with other social institutions are discussed.

SOCI 444. Health Disparities. 3 Units.
We have come to understand that stark disparities in health result from the social organization of society, especially inequality in resources and opportunities between and within social groups in the population. This seminar course examines the differential distribution of health and illness in society, focusing on the social determinants of health. Topics include: socioeconomic inequality; geographic context; social cohesion and exclusion; health burden in minority populations; policy and federal priorities. We utilize a life course perspective to understand how inequality "gets under the skin" to produce adverse health. Offered as SOCI 344 and SOCI 444. Counts for CAS Global & Cultural Diversity Requirement.

SOCI 445. Sociology of Mental Illness. 3 Units.
Focus is on social construction of mental health and illness and sociology of emotions. Social determinants of psychological distress will be discussed along with social stigma associated with mental illness. Institutional and community options for care of the mentally ill will be considered along with the impact of recent social movements of deinstitutionalization and independent living. Offered as SOCI 345 and SOCI 445.

SOCI 447. Sociology of Education. 3 Units.
This course provides an introduction to the field of sociology of education, which might be more properly called sociology of schooling. We will examine the development of schools historically and competing paradigms for understanding the place of school in society. Major theoretical perspectives concerning the nature and consequences of schools for individuals and for societies will be reviewed. Issues of individual opportunity - including how it is organized by race, class, and gender - will be covered, as well as issues institutional dynamics - including tracking, testing and so-called crisis and reform. Offered as SOCI 347 and SOCI 447.

SOCI 449. Social Inequality. 3 Units.
This course discusses classical theory and contemporary research on the mechanisms of power that produce inequalities in income, wealth, education, privilege, and occupational prestige and are manifest in racial, ethnic, gender, age, health, and sexual hierarchies. Offered as SOCI 349 and SOCI 449.

SOCI 455. Special Topics. 3 Units.
One or more sections each semester focusing on selected areas of study in sociology. Offered as SOCI 355 and SOCI 455.

SOCI 460. The Sociology of Law. 3 Units.
This course will focus on the role of rights in the U.S. legal system and society. In particular, we will consider three questions. The first is how do rights fit in the legal system and society? Second, how have different social groups used and thought about rights? Third, how do legal actors like judges and lawyers think about rights compared to non-lawyers? Offered as SOCI 360 and SOCI 460.

SOCI 461. The Life Course. 3 Units.
Individual experiences and transitions over the life course are considered as the result of societal, cultural, psychological, biological, and historical influences. Developmental issues of childhood, adolescence, young adulthood, middle years and late life are discussed in the context of social expectations, challenges, and opportunities. Emphasis is placed on theoretical readings. Offered as SOCI 361 and SOCI 461.

SOCI 464. Disability and Society. 3 Units.
This course considers and examines the relationship between disability and society. The course covers how we define, represent, and react to disability in modern society. This includes an analysis of stigma and discrimination. We also explore the timing and experience of disability from a life-course perspective. Finally, we examine the political, social, and economic influences on disability, including the Disability Rights movement. Offered as SOCI 364 and SOCI 464.

SOCI 465. Health Care Delivery. 3 Units.
Health care in the U.S. may be approaching a critical cross-road. Limiting care to older persons and the chronically ill has been proposed as a means to combat rising costs and limited access to health care. What are the alternatives to health care rationing? Socialized medicine? National health insurance? This course deals with issues of cost, quality, and access to health care in the United States and other societies. It considers how solutions by other societies can provide directions for the organization of health care in the U.S. Offered as SOCI 365 and SOCI 465.
SOCI 466. Promoting Health Across Boundaries. 3 Units.
This course examines the concepts of health and boundary spanning and how the synergy of the two can produce new, effective approaches to promoting health. Students will explore and analyze examples of individuals and organizations boundary spanning for health to identify practice features affecting health, compare and contrast practices and approaches, and evaluate features and context that promote or inhibit boundary spanning and promoting health. Offered as MPHP 466, PQHS 466, SOCI 466, NURS 466 and BETH 466. Prereq: Graduate student status or instructor consent.

SOCI 469. Aging in American Society. 3 Units.
Considers the position and participation of aged adults in American society. Sociological perspectives through which to interpret the aging process and old age; social policies; intergenerational relations; lifestyles and how they affect participation of the aged in American society; dying and death serve as major themes. Offered as SOCI 369 and SOCI 469.

SOCI 470. Sociology of the Family. 3 Units.
This course provides the theoretical and methodological foundation for conducting family research. It also reviews the most current research in the sociology of the family arena such as intergenerational issues, ethnicity and gender, and family transitions. Offered as SOCI 370 and SOCI 470.

SOCI 472. Work and Family: U.S. and Abroad. 3 Units.
Covers the impact on human lives of the interface between work and family; the different ways gender structures the experience of work and family depending upon racial and ethnic background, social class, age, and partner preference; the impact of historical context on work-family experiences; work-family policies in the United States and other countries. Offered as SOCI 372, WGST 372, and SOCI 472.

SOCI 474. Using Law to Designate Public-Private Boundaries for Social Policies. 3 Units.
This course studies law and the public-private dichotomy. With a basis in important research on the sociology of law, it considers three questions: 1) What is the impact of "law" on the boundary separating the public and private sectors? 2) How does "law" designate which actors and institutions belong to the public and private sectors? 3) Is the public-private dichotomy adequate for sociological analyses of law and its influences? If not, what alternatives to the public-private dichotomy can we offer? Offered as SOCI 374 and SOCI 474. Prereq: SOCI 101.

SOCI 477. Population Dynamics and Changing Societies. 3 Units.
Population and social structure are inextricably linked, as changes in one elicit changes in the other. Social demography, as a discipline, examines these linkages through the systematic study of the size, composition and distribution of populations and their relationship to the social, political and economic organization of societies. This course will pay particular attention to mortality, morbidity and health, fertility, family and household organization, and migration as the major processes of population change. The population dynamics of the United States will be emphasized, with select comparisons to developing and developed countries. Offered as SOCI 377 and SOCI 477. Prereq: SOCI 101 or equivalent; 9 hours in SOCI, ANTH, or ECON.

SOCI 481. City as Classroom. 3 Units.
In this course, the city is the classroom. We will engage with the urban terrain. We will meet weekly off-campus, interact with community members, and interface--both literally and figuratively--with the city as a way to examine the linkages between historical, conceptual, and contemporary issues, with particular attention paid to race and class dynamics, inequality, and social justice. This course will have four intersecting components, primarily focusing on American cities since the 1930s: the social and physical construction of urban space, the built environment, life and culture in the city, and social movements and grassroots struggles. Offered as HSTY 381, POSC 381, SOCI 381, HSTY 481, POSC 481, and SOCI 481. Counts for CAS Global & Cultural Diversity Requirement.

SOCI 509. Advanced Statistical Analysis. 3 Units.
Research in social epidemiology, health service research and other applied fields increasingly demands an understanding of social research methodology. This seminar exposes students to state of the art analyses of data science data including: data preparation, factor analysis, regression and structural equation modeling. Students are provided the opportunity to interpret and critically evaluate the methodology used in journal articles, with an emphasis on data analytical techniques. Students will analyze data sets using SPSS and EQS. Prereq: SOCI 407 and (STAT 401 or SOCI 406).

SOCI 514. Qualitative Methods/Field Research. 3 Units.
Students explore the theoretical foundations of qualitative social research. The course is designed to introduce and provide experience with a range of data generation strategies and analytic skills. The ethnographic techniques of semi-structured interviewing and participant-observation receive particular attention.

SOCI 525. Multilevel Modeling. 3 Units.
This course is designed to provide an introduction to multilevel, or hierarchical, regression models, and to explore its two primary applications in the social sciences: (1) studies of individuals nested within groups; (2) studies of repeated observations nested within individuals. After taking this course, students should be able to discuss the components of the multilevel model, including random intercepts & slopes, variances at levels 1 & 2, within- and between-group regressions. Students should also be able to conduct independent statistical analysis using Stata from initial tests of assumptions and hypothesis testing, and to assessing model fit. This course will additionally provide instruction on time-based and age-based latent growth curves within the multilevel modeling framework. Prereq: SOCI 509 or requisites not met permission.

SOCI 601. Reading and Research. 1 - 9 Units.
Individual study and/or project work.

SOCI 701. Dissertation Ph.D.. 1 - 9 Units.
Dissertation work. Preceptor consent required. A maximum of 9 credit hours in this course may be counted toward graduation requirements.

Teacher Licensure Program
Cleveland Hearing & Speech 419
www.case.edu/arts/sci/teachlic
Phone: 216.368.0792; Fax: 216.368.5227
Denise Davis, Director of Teacher Education
denise.k.davis@case.edu

Case Western Reserve University offers several programs leading to the Ohio teaching license. Teacher Education programs are offered in Art Education and Music Education at the undergraduate (Bachelor of Science) and graduate (Master of Arts) level. A unique feature of these...
programs is that each is offered in cooperation with a University Circle Institution—the Cleveland Institute of Art and the Cleveland Institute of Music.

In addition, several departments in the College of Arts and Sciences offer undergraduate majors leading to Ohio teaching licenses. Students wishing to pursue a teaching license in one of these areas must fulfill all the requirements for their primary major and declare teacher education as a second major, following the appropriate course sequences that lead to licensure. The teacher licensure areas are: 1) Adolescent to Young Adult (grades 7-12) in Integrated Language Arts (English major), Integrated Social Studies (history major), Integrated Mathematics (mathematics major), Life Science (biology major), or Physical Science (chemistry or physics major); and 2) Multi-Age (grades preK-12) in French, Spanish, or Latin.

Teacher education programs at Case Western Reserve University lead to teaching licenses and are approved by the Ohio Department of Education and the Ohio Department of Higher Education.

The Teacher Education Unit at CWRU is nationally accredited by the Teacher Education Accreditation Council (TEAC), which is part of the Council for the Accreditation of Educator Preparation (CAEP). In addition, the National Association of Schools of Music (NASM) accredits the Music Education Program.

**Undergraduate Programs**

**Ohio Teacher Education Programs**

Students interested in a teaching career will pursue a primary major in the field of licensure (for which CWRU has received approval from the Ohio Department of Education and the Ohio Department of Higher Education) and choose teacher education as a second major. This second major requires 36 credit hours in professional education.

Adolescence to Young Adult teacher licensure (grades 7-12) is available in Integrated Language Arts (English major), Integrated Social Studies (history major), Integrated Mathematics (mathematics major), Life Science (biology major), or Physical Science (chemistry or physics major). Multi-Age licensure (grades PreK-12) is available in French, Spanish, or Latin. For information concerning specific subject area requirements, go to the departmental descriptions for Biology, Chemistry, Physics, or Spanish. For information concerning specific subject area requirements, go to the departmental descriptions for Biology, Chemistry, Physics, or Spanish. However, for specific subject areas, go to the departmental descriptions for Biology, Chemistry, Physics, or Spanish.

The education course requirements for the AYA or Multi-Age Language programs are as follows:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDUC 255</td>
<td>Literacy Across the Content Areas</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 301</td>
<td>Introduction to Education</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 304</td>
<td>Educational Psychology</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 325</td>
<td>Content Area Special Methods I</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 326</td>
<td>Content Area Special Methods II</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 338</td>
<td>Seminar and Practicum in Adolescents</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 340</td>
<td>Advanced Curriculum and Methods</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 386</td>
<td>Introduction to Instructional Technology</td>
<td>3</td>
</tr>
<tr>
<td>EDUC 390</td>
<td>Student Teaching &amp; Professional Development Seminar</td>
<td>3</td>
</tr>
</tbody>
</table>

Students must maintain a 3.0 GPA in all professional education courses, a 2.7 GPA in the specific content area, and a cumulative overall GPA of 2.7 to be recommended for Ohio teacher licensure.

As noted in the Overview, Case Western Reserve University also offers teacher licensure programs in Art Education and Music Education at the undergraduate (Bachelor of Science) and graduate (Master of Arts) levels. For further information on program and course requirements for Art Education, see the Department of Art History and Art (p. 191) description in this bulletin; for Music Education, see the Department of Music (p. 426) description.

**Program Faculty**

**Denise K. Davis, EdD**
(Teachers College, Columbia University)
*Full-time Lecturer, Department of Music; Director, Teacher Licensure Program*

**Joseph Marencik, EdD**
(Northcentral University)
*Part-time Lecturer, Department of Music*

**Matthew Garrett, PhD**
(Florida State University)
*Associate Professor, Department of Music*

**Lisa L. Koops, PhD**
(Michigan State University)
*Associate Professor, Department of Music*

**Nathan Kruse, PhD**
(Michigan State University)
*Associate Professor, Department of Music*

**Part-time Lecturer, Department of Music**

**Part-time Lecturer, Department of Art History and Art**

**Kathleen Horvath, PhD**
(The Ohio State University)
*Associate Professor, Department of Music*

**David King, MFA**
(Kent State University)
*Part-time Lecturer, Department of Art History and Art*

**Lisa L. Koops, PhD**
(Michigan State University)
*Associate Professor, Department of Music*

**Part-time Lecturer, Department of Art History and Art**

**Art Education**
Courses

**EDUC 200. Introduction to Supplemental Instruction (SI). 1 Unit.**
This course is designed to develop and reinforce skills necessary for facilitating Supplemental Instruction through the use of pedagogical knowledge, Instructional strategies, understanding of learning theory, understanding the principles and techniques of differentiated Instruction, and understanding group dynamics. Prereq: Cumulative GPA of 3.25.

**EDUC 255. Literacy Across the Content Areas. 3 Units.**
Literacy development is examined through various perspectives. This three hour course emphasizes understanding reading and writing as it applies to the various content areas. The course includes instruction in using protocols for oral language development, strategies for word skill development and reading comprehension, strategies for addressing dyslexia, and use of assessment of reading skills. Students apply strategies through various field experiences.

**EDUC 301. Introduction to Education. 3 Units.**
This course provides an introduction to the historical, sociological, and philosophical role of education in a diverse society. Historic and contemporary practices and issues are introduced and explored within the context of educational ideologies. Emphases include examination of what success in education means and beginning the process of defining one's own identity as a teacher. Offered as EDUC 301 and EDUC 401.

**EDUC 304. Educational Psychology. 3 Units.**

**EDUC 325. Content Area Special Methods I. 3 Units.**
This methods course, designed for licensure candidates in secondary or multi-age areas, specifically emphasizes the methods inherent in teaching the subject area of licensure. The first of two courses, EDUC 325 builds on the student's previous understanding of the methods involved in teaching their particular subject. The course will consist of weekly guided observations in a local high school classroom under the mentoring of a master teacher, various forms of exploring content and pedagogy, and monthly discussions in a special format called the "Reflective Triad" - composed of each CWRU student, his/her master teacher in the high school, and a CWRU faculty member in the content area. Additionally, the course involves introductory lesson design and teaching. Prereq: EDUC 301, EDUC 304.

**EDUC 326. Content Area Special Methods II. 3 Units.**
This methods course, designed for licensure candidates in secondary or multi-age areas, specifically emphasizes the methods inherent in teaching the subject area of licensure. This course is a continuation of the sequence and is the second of two courses. EDUC 326 continues students' work in the first seminar to understand, design and teach their content. The course consists of weekly guided observations in a local high school classroom under the mentoring of a master teacher, various forms of exploring content and pedagogy, and monthly discussions in a special format called the "Reflective Triad" - composed of each CWRU student, his/her master teacher in the high school, and a CWRU faculty member in the content area. Additionally, the course involves more sophisticated lesson design in the content area, content integration, an introduction to designing instruction to meet the needs of diverse learners, and teaching. Prereq: EDUC 301, EDUC 304, EDUC 325.

**EDUC 338. Seminar and Practicum in Adolescents. 3 Units.**
Supervised field placement and attendance in early childhood, child, and adolescent settings including preschools, schools, hospitals, and neighborhood centers. This class is used to fulfill requirements by the Ohio Department of Education teacher licensure program. Recommended preparation: PSCL 101, EDUC 301, EDUC 304, and permission of program director. Offered as EDUC 338, PSCL 338, and SOCI 338.

**EDUC 340. Advanced Curriculum and Methods. 3 Units.**
This curriculum and methods course is offered for students enrolled in the high school or Multi-Age Languages teacher licensure program. It involves in-depth study of pedagogy within an integrated and interdisciplinary model. Demonstrated understanding of constructivist theory, the application of developmental and learning theories, and state and national standards in curriculum content, curriculum design, instruction and assessment are central to the course. Counts as SAGES Departmental Seminar. Prereq: EDUC 301, EDUC 304, EDUC 325, EDUC 326.

**EDUC 386. Introduction to Instructional Technology. 3 Units.**
This course is designed to address the basic technology skills, which are required of all teachers. The course uses both concept and project based learning activities. Each of the projects is centered on a set of activities designed to allow students to demonstrate a particular subset of competencies. The course will not always provide step-by-step directions for completing projects; instead it will promote the use of existing information and help resources to allow students to develop the ability to learn new technology independently. Each of the projects will also contain the opportunity for the student to reflect on how technology impacts their teaching. Course projects are designed to assess both a basic comfort level with learning and using technology tools and the student's ability to apply technology to improve teaching and learning. The nature of the course is a mix of technology and should engage teachers in thinking about ways to improve their teaching. Offered as EDUC 386 and EDUC 486.
EDUC 304 and EDUC 404. graduate students. Recommended preparation: PSCL 101. Offered as development. Application of research to instructional methodologies.


EDUC 390C. Student Teaching Capstone & Professional Development Seminar. 3 Units. This course is taken in conjunction with student teaching and emphasizes the integration of theory and practice. The course provides a forum for processing what students experience throughout the semester as students engage in full-time work in the classroom. The course also includes components that fulfill the SAGES Senior Capstone requirement. The course guides the professional development of each student as he or she compiles the portfolio, completes the Capstone, and prepares for state licensure exams. Counts as SAGES Senior Capstone. Prereq: EDUC 255, EDUC 386, EDUC 340. Coreq: EDUC 394.

EDUC 394. Student Teaching Practicum. 9 Units. This practicum represents a fifteen week student teaching experience involving curriculum design and implementation. Each student teacher plans and teaches a comprehensive unit, moving from guided practice to assuming full teacher responsibility within the school culture. Video analysis, pre- and post-teaching lesson analyses, problem-solving, and reflective dialogue are key emphases of the practicum. The Teacher Performance Assessment is a component of the student teaching.

EDUC 390. Student Teaching & Professional Development Seminar. 3 Units. This course is taken in conjunction with student teaching and provides a forum for processing what students experience throughout the semester. Additionally, the course guides the professional development of each student. The course helps students integrate state and national standards in their teaching. The Teacher Performance Assessment (TPA) is addressed in this course and becomes part of the student teaching portfolio. Individual advisement is a critical component and involves resume writing, interview skills, job placement information and preparation for state mandated licensure exams. Prereq: EDUC 301, EDUC 304, EDUC 325, EDUC 326, EDUC 340. Coreq: EDUC 394 - Student Teaching Seminar.

EDUC 495. Independent Study in Education. 1 - 3 Units. Independent Study in Education is offered for students with special interests and/or commitments that are not fully addressed in other education courses and who wish to work independently.

Department of Theater

Eldred Hall
www.case.edu/artsci/thtr
Phone: 216.368.4868; Fax: 216.368.5184
Jerrold Scott, Department Chair
jerrold.scott@case.edu

The Department of Theater at Case Western Reserve University offers education and participation in all aspects of drama, with course offerings in acting, stagecraft, costume design, scene design, directing, dramatic writing, and history, literature, and criticism. Bachelor of Arts students have the opportunity to perform as well as to serve on the design and technical teams in four fully produced mainstage theatrical productions each year. The low student-to-faculty ratio ensures that students are able to work closely with our faculty of highly accomplished artists and scholars. Recognizing that theater is a discipline belonging to the humanities as well as to the performing arts, the department treats all productions as artistic and educational experiences, and welcomes the participation of students regardless of their academic majors and career goals.

At the graduate level, the Master of Arts degree prepares students for work in professional theater or education or for pursuit of further graduate study, while the Master of Fine Arts professional actor training program—a collaboration between the Department of Theater and Cleveland Play House—represents a unique alliance between one of the oldest academic theater programs in the United States and the nation's first regional theater.

Undergraduate Programs

Theater Major

The Bachelor of Arts program in theater offers concentrations in acting, design/technical theater, dramatic writing, history, and directing. Students intending to major in theater must complete 40 hours of course work. Most students will opt to take many classes beyond the requirements in order to enhance their knowledge and improve their skills. Students interested in declaring a specific concentration of study can satisfy the additional requirements listed below in order to fulfill a Bachelor of Arts with a specific concentration. Students who do not declare a
concentration will receive the designation of "General Theater" on their transcript.

The basic course requirements for all theater majors are as follows:

### Performance courses: Students must take all four of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 102</td>
<td>Acting I for Majors</td>
<td>3</td>
</tr>
<tr>
<td>THTR 103</td>
<td>Acting II</td>
<td>3</td>
</tr>
<tr>
<td>THTR 110</td>
<td>Introduction to Theater</td>
<td>3</td>
</tr>
<tr>
<td>THTR 330</td>
<td>Play Directing I</td>
<td>3</td>
</tr>
</tbody>
</table>

### Design courses:

All students must take the following course as a prerequisite, preferably in the spring of their first year:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 111</td>
<td>Introduction to Design</td>
<td>3</td>
</tr>
</tbody>
</table>

Students must take one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 223</td>
<td>Scenic Design</td>
<td>3</td>
</tr>
<tr>
<td>THTR 224</td>
<td>Lighting Design</td>
<td>3</td>
</tr>
<tr>
<td>THTR 225</td>
<td>Costume Design</td>
<td>3</td>
</tr>
</tbody>
</table>

### Theater history courses: Students must take all four of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 325</td>
<td>Development of Theater: Beginnings to English Renaissance</td>
<td>3</td>
</tr>
<tr>
<td>THTR 326</td>
<td>Development of Theater: Renaissance to Romanticism</td>
<td>3</td>
</tr>
<tr>
<td>THTR 327</td>
<td>American Drama</td>
<td>3</td>
</tr>
<tr>
<td>THTR 329</td>
<td>Modern and Contemporary Drama</td>
<td>3</td>
</tr>
</tbody>
</table>

Students who study abroad at RADA will receive credit for THTR 301, THTR 302, THTR 303, THTR 304, and THTR 305. Three of these courses can satisfy the requirements for THTR 325, THTR 326, and THTR 329.

### Tech credit hours (minimum of 3 hours)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 185</td>
<td>Theater Practicum (Students are required to enroll in THTR 185, a 1-hour practicum credit, accumulating 7 credits during their 8 semesters at CWRU. Students will enroll in THTR 185 each semester unless instructed to do otherwise by the director of undergraduate theater studies. Any exemptions to this requirement—receiving 2 credit hours in 1 semester or not enrolling in THTR 185 for a semester—must receive approval from the director of undergraduate theater studies.)</td>
<td>3</td>
</tr>
</tbody>
</table>

### Senior capstone: Students must take one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 331</td>
<td>Play Directing II</td>
<td>3</td>
</tr>
<tr>
<td>THTR 390</td>
<td>Advanced Topics in Design/Technology</td>
<td>3</td>
</tr>
<tr>
<td>THTR 393</td>
<td>Senior Capstone: Dramaturgy</td>
<td>3</td>
</tr>
</tbody>
</table>

### Elective Courses

Students may enroll in additional theater courses beyond the 40 credits required for the major. Some of the courses in the list below can be counted toward the major requirements or taken as electives.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 100</td>
<td>Introduction to Acting</td>
<td>3</td>
</tr>
</tbody>
</table>

### Concentration in Acting

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 231</td>
<td>Acting III: Contemporary Technique</td>
<td>3</td>
</tr>
<tr>
<td>THTR 232</td>
<td>Acting IV: Classical Technique</td>
<td>3</td>
</tr>
<tr>
<td>THTR 375</td>
<td>Voice for the Stage I</td>
<td>3</td>
</tr>
</tbody>
</table>

Students who study abroad at RADA will receive credit for THTR 303 and THTR 305, which can satisfy the concentration requirements for THTR 231 and THTR 375.

### Total Units

Concentration in Design/Technical Theater

The two remaining design courses (excluding the course taken to fulfill the core requirements) from THTR 223, THTR 224, and THTR 225

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 226</td>
<td>Stage Makeup</td>
<td>3</td>
</tr>
<tr>
<td>THTR 227</td>
<td>Stage Management</td>
<td>3</td>
</tr>
<tr>
<td>THTR 231</td>
<td>Acting III: Contemporary Technique</td>
<td>3</td>
</tr>
<tr>
<td>THTR 232</td>
<td>Acting IV: Classical Technique</td>
<td>3</td>
</tr>
<tr>
<td>THTR 301</td>
<td>Study Abroad at RADA: Dramatic Literature I</td>
<td>3</td>
</tr>
<tr>
<td>THTR 302</td>
<td>Study Abroad at RADA: Dramatic Literature II</td>
<td>3</td>
</tr>
<tr>
<td>THTR 303</td>
<td>Study Abroad at RADA: Acting Styles</td>
<td>3</td>
</tr>
<tr>
<td>THTR 304</td>
<td>Study Abroad at RADA: Dramatic Literature III</td>
<td>3</td>
</tr>
<tr>
<td>THTR 305</td>
<td>Study Abroad at RADA: Vocal Performance</td>
<td>3</td>
</tr>
<tr>
<td>THTR 306</td>
<td>Acting V: Camera Technique</td>
<td>3</td>
</tr>
<tr>
<td>THTR 311</td>
<td>Audition Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>THTR 312</td>
<td>Playwriting</td>
<td>3</td>
</tr>
<tr>
<td>THTR 314</td>
<td>Advanced Playwriting</td>
<td>3</td>
</tr>
<tr>
<td>THTR 316</td>
<td>Screenwriting</td>
<td>3</td>
</tr>
<tr>
<td>THTR 323</td>
<td>Topics in Design</td>
<td>3</td>
</tr>
<tr>
<td>THTR 334</td>
<td>Shakespeare: Histories and Tragedies</td>
<td>3</td>
</tr>
<tr>
<td>THTR 335</td>
<td>Shakespeare: Comedies and Romances</td>
<td>3</td>
</tr>
<tr>
<td>THTR 375</td>
<td>Voice for the Stage I</td>
<td>3</td>
</tr>
<tr>
<td>THTR 376</td>
<td>Voice for the Stage II</td>
<td>3</td>
</tr>
<tr>
<td>THTR 385</td>
<td>Rehearsal and Production</td>
<td>1-3</td>
</tr>
<tr>
<td>THTR 386</td>
<td>Rehearsal and Performance</td>
<td>1</td>
</tr>
<tr>
<td>THTR 397</td>
<td>Honors Studies I</td>
<td>3</td>
</tr>
<tr>
<td>THTR 398</td>
<td>Honors Studies II</td>
<td>3</td>
</tr>
<tr>
<td>THTR 399</td>
<td>Independent Study in Theater Arts</td>
<td>1-3</td>
</tr>
</tbody>
</table>

### Total Units

Concentration in Design/Technical Theater

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 226</td>
<td>Stage Makeup</td>
<td>3</td>
</tr>
<tr>
<td>THTR 227</td>
<td>Stage Management</td>
<td>3</td>
</tr>
<tr>
<td>THTR 231</td>
<td>Acting III: Contemporary Technique</td>
<td>3</td>
</tr>
<tr>
<td>THTR 232</td>
<td>Acting IV: Classical Technique</td>
<td>3</td>
</tr>
<tr>
<td>THTR 375</td>
<td>Voice for the Stage I</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units 9
Concentration in Directing

THTR 331  Play Directing II  3
THTR 227  Stage Management  3
Either THTR 314 (Advanced Playwriting) or an additional design course (THTR 223, THTR 224, or THTR 225) not taken to fulfill the core requirements of the major.  3

Total Units  9

Concentration in Dramatic Writing

THTR 312  Playwriting  3
THTR 314  Advanced Playwriting  3
THTR 316  Screenwriting  3

Total Units  9

Departmental Honors in Theater

Majors wishing to take a Bachelor of Arts degree with honors in theater must make written application to the director of undergraduate theater studies no later than May 1 of their junior year. Students must have a minimum 3.25 overall grade point average and a minimum 3.75 grade point average in theater. Acceptance into the honors program is contingent upon faculty support and recommendation by the director of undergraduate theater studies and the department chair.

Those accepted register for THTR 397 Honors Studies I and THTR 398 Honors Studies II during their senior year, for a total of 6 hours. The honors project is defined as a production project in acting, design, playwriting, directing, or management/outreach. A supporting paper discussing the concept, execution, and performance of the project must be filed with the director of undergraduate theater studies no later than one week following the project presentation. Preparation of the project will be supervised by a department faculty member.

This project may be accepted for honors only if it receives a grade of A from both the project advisor and the director of undergraduate theater studies. The grade of A must be received both semesters. Students who qualify will receive the notation “Departmental Honors in Theater” on their diplomas. Information about the structure and specific requirements of the honors project is available from the director of undergraduate theater studies.

Minor

A minor in theater requires 18 hours. The requirements for each concentration are as follows:

General Theater

Required Courses:

- THTR 101  Acting I For Minors  3
- THTR 110  Introduction to Theater  3
- THTR 111  Introduction to Design  3

One of the following two courses:

- THTR 325  Development of Theater: Beginnings to English Renaissance  3
- THTR 326  Development of Theater: Renaissance to Romanticism  3

Plus two additional courses above the 200 level

Acting

THTR 101  Acting I For Minors  3
THTR 103  Acting II  3

THTR 201  Movement for the Actor  3
THTR 231  Acting III: Contemporary Technique  3
THTR 375  Voice for the Stage I  3
One of the following two courses:

- THTR 325  Development of Theater: Beginnings to English Renaissance  3
- THTR 326  Development of Theater: Renaissance to Romanticism  3

Graduate Programs

Master of Arts in Theater

Master of Arts students prepare for careers in the professional theater and education, or for further pursuit of graduate study. The MA degree program offers broad-based advanced study in the literature and critical analysis of theater, with the opportunity to focus in a specialization of the student’s choice. A bachelor’s degree and strong academic record are required for admission; although no specific undergraduate degree requirements exist, a background in drama is obviously helpful.

Requirements for the degree include:

1. A minimum of 30 hours of course work beyond the bachelor’s degree
2. A cumulative GPA of 3.0 or better for all course work
3. Successful completion of the thesis/project

The curriculum consists of 15 hours of course work, 6 hours of specialized focus, and 9 hours of master's project or thesis writing.

All MA students must take the following courses (15 hours):

- THTR 425 Development of Theater: Beginnings to English Renaissance (3)
- THTR 426 Development of Theater: Renaissance to Romanticism (3)
- THTR 427 American Drama: American Drama (3) or THTR 429 Modern and Contemporary Drama (3)
- THTR 501 Text Analysis for the Actor (3)
- THTR 509 Seminar: Performance Theory (3)

Students may then select from specific interest course tracks (6 hours), such as:

- Directing (taking THTR 430 Play Directing I (3) and THTR 431 Play Directing II (3))
- Dramatic Writing (taking THTR 412 Playwriting (3) and THTR 414 Advanced Playwriting (3) or THTR 412 Playwriting (3) and THTR 416 Screenwriting (3))
- Theater Studies (two courses in the Department of Theater or in another department, selected by student with consent of the advisor and the approval of the theater graduate program (6 total))

Finally, students must take 9 hours of THTR 644 M.A. Project. The project or thesis must be agreed upon with the student's advisor and have the approval of the department.

**Master of Fine Arts in Acting**

In 1996, The Cleveland Play House (CPH) and Case Western Reserve University joined forces to create a new Master of Fine Arts program in acting. Students begin their involvement with the Play House in their first semester, and their level of involvement steadily increases until, in the third year, they become professional interns at CPH.

The MFA in acting is a terminal professional degree. Candidacy for the program requires an undergraduate degree with (ideally) a major in theater, equivalent training and experience, or demonstrable potential for work at the MFA level. In addition, candidates must provide evidence of technical skill and creative ability.

At the end of each semester in residence, the student's skill and creative ability are evaluated in light of his or her work in the department. Only students who have clearly demonstrated growth and excellence are permitted to remain in the program. The award of the MFA degree is contingent upon the student's academic progress and upon the assessment on the part of the faculty that the candidate possesses the potential to work in the field of theater on a professional level.

Requirements for the MFA degree include:

1. A minimum of 60 semester hours of graduate work beyond the bachelor’s degree
2. A cumulative grade point average of 3.0 for all course work on the graduate level
3. Completion of the course requirements for the MFA Thesis Portfolio
4. Successful completion of the Third Year Internship at The Cleveland Play House

Course requirements for the MFA in acting are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courses in acting, including script analysis, implementation of acting theory, characterization, modernist playwrights, and Shakespeare</td>
<td>18</td>
</tr>
<tr>
<td>Courses in movement, chosen from mask work, period styles, stage combat, and commedia</td>
<td>12</td>
</tr>
<tr>
<td>Courses in voice, chosen from voice production, articulation, and interpretation</td>
<td>9</td>
</tr>
<tr>
<td>Courses in speech, using Edith Skinner techniques, dialects, verse and lyric drama, and Shakespeare</td>
<td>6</td>
</tr>
<tr>
<td>Courses in performance theory, projects, and professional seminars</td>
<td>6-9</td>
</tr>
</tbody>
</table>

Two of the following courses in creative thesis:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>THTR 401 Graduate Movement I: Corporeal Mime</td>
<td>6</td>
</tr>
<tr>
<td>THTR 402 Graduate Movement II: Neutral Mask</td>
<td></td>
</tr>
<tr>
<td>THTR 403 Graduate Movement III: Expressive Masks</td>
<td></td>
</tr>
<tr>
<td>THTR 404 Graduate Movement IV: Commedia</td>
<td></td>
</tr>
<tr>
<td>THTR 473 Graduate Voice Technique I</td>
<td></td>
</tr>
<tr>
<td>THTR 474 Graduate Voice Technique II</td>
<td></td>
</tr>
<tr>
<td>THTR 475 Graduate Voice Technique III: Classical Texts</td>
<td></td>
</tr>
<tr>
<td>THTR 479 Graduate Stage Speech I: Phonetics</td>
<td></td>
</tr>
<tr>
<td>THTR 501 Text Analysis for the Actor</td>
<td></td>
</tr>
<tr>
<td>THTR 509 Seminar: Performance Theory</td>
<td></td>
</tr>
<tr>
<td>THTR 512 Graduate Audition Lab</td>
<td></td>
</tr>
<tr>
<td>THTR 530 Ensemble Technique</td>
<td></td>
</tr>
<tr>
<td>THTR 531 Graduate Acting I: Performance Process</td>
<td></td>
</tr>
<tr>
<td>THTR 532 Graduate Acting II: Ensemble Improvisations</td>
<td></td>
</tr>
<tr>
<td>THTR 533 Graduate Acting III: The Modernists</td>
<td></td>
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<tr>
<td>THTR 534 Graduate Acting IV: Shakespeare/Heightened Language</td>
<td></td>
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<tr>
<td>THTR 540 Seminar: Professional Orientation</td>
<td></td>
</tr>
<tr>
<td>THTR 579 Graduate Stage Speech II: Articulation</td>
<td></td>
</tr>
<tr>
<td>THTR 580 Graduate Stage Speech III: Dialects</td>
<td></td>
</tr>
<tr>
<td>THTR 581 Graduate Stage Speech IV: Classical Texts</td>
<td></td>
</tr>
<tr>
<td>THTR 601 Special Projects</td>
<td></td>
</tr>
<tr>
<td>THTR 610 Professional Internship</td>
<td></td>
</tr>
<tr>
<td>THTR 630 Performance Studio</td>
<td></td>
</tr>
<tr>
<td>THTR 642 Thesis Portfolio I</td>
<td></td>
</tr>
<tr>
<td>THTR 643 Thesis Portfolio II</td>
<td></td>
</tr>
</tbody>
</table>

Total Units 57-60
Department Faculty

Jerrold Scott, MFA  
(University of South Carolina)  
Katharine Bakeless Nason Professor of Theater and Chair; Artistic Director of Eldred Theater  
Directing; acting; speech and dialects

Jill Davis, MFA  
(Temple University)  
Associate Professor  
Scene design; lighting design

Angelina M. Herin, MFA  
(University of South Carolina)  
Associate Professor  
Costume design

Shanna Beth McGee, MFA  
(University of Georgia)  
Professor  
Voice

Jeffrey Ullom, PhD  
(University of Illinois, Champaign-Urbana)  
Associate Professor; Director of Undergraduate Theater Studies  
Dramatic literature; theater history

David Vegh, MFA  
(California State University-Long Beach)  
Assistant Professor  
Acting; audition laboratory; film acting

Visiting Faculty

Christopher Bohan, MFA  
(Wayne State University)  
Visiting Assistant Professor  
Acting; movement

Lecturer

Anaya Farrell, BA  
(McGill University)  
Part-time Lecturer  
Acting

Adjunct Faculty

Donald Carrier, BCom  
(Webber Douglas Academy of Dramatic Art)  
Adjunct Associate Professor; Associate Director, MFA Acting Program  
Acting; script analysis

Laura Kepley, MFA  
(Brown University/Trinity Repertory Theatre)  
Adjunct Associate Professor, Artistic Director, Cleveland Play House

Kevin Moore, MA  
(Indiana University)  
Adjunct Associate Professor, Managing Director, Cleveland Play House

Courses

THTR 100. Introduction to Acting. 3 Units.  
A course designed to provide the non-major or undeclared liberal arts major experience with a basic understanding of acting and performance. Fundamentals in improvisation, vocabulary, and scene study are stressed. This course fulfills THTR 101 or THTR 102 should the undeclared student select theater as his or her major or minor. Students may receive credit for only one of THTR 100, THTR 101, or THTR 102.

THTR 101. Acting I For Minors. 3 Units.  
This course is designed to expose the theater minor to the development of the actor's basic tools. Relaxation, concentration, and improvisation are taught along with basic scene study work. Students may receive credit for only one of THTR 100, THTR 101, or THTR 102.

THTR 102. Acting I for Majors. 3 Units.  
This course is designed to expose the theater major to the development of the actor's basic tools. Relaxation, concentration, and improvisation are taught along with basic scene study work. Students may receive credit for only one of THTR 100, THTR 101, or THTR 102.

THTR 103. Acting II. 3 Units.  
This course continues the work begun in THTR 101 or THTR 102 with emphasis on action, emotional life, and text analysis as the essential elements of the actor's work. Prereq: THTR 100, THTR 101, or THTR 102.

THTR 105. Introduction to Stagecraft. 3 Units.  
An introduction to theater terminology and technology with an emphasis on scenic construction, lighting, stage rigging, painting, and production. A practicum in wood shop and stage construction.

THTR 110. Introduction to Theater. 3 Units.  
THTR 110 is a fundamental study of theatre from the standpoint of developing the critical acumen of a potential audience. It covers each ingredient of the theatrical experience—audience, playwriting, acting, directing, theatre architecture, design and technology—and attempts to help students define a reasonable set of standards to judge that part of the experience as an audience member and to clearly communicate their feelings and thoughts regarding that experience. The primary textbook is Edward Wilson's The Theatre Experience, former theatre critic for The Wall Street Journal. Readings in this text are augmented by the reading of specific plays that represent different periods, genres, conventions, and dramatic styles. Representative plays (typically six each semester) include Oedipus Rex (Sophocles), Hamlet (Shakespeare), Tartuffe (Moliere), Uncle Vanya (Chekhov), Waiting for Godot (Beckett), and Angels in America (Kushner). Many of these plays are supplemented by short films prepared by Films for the Humanities so that students can see examples of various dramatic and theatrical styles in performance. In addition to class discussions, lectures, and readings, students are also required to attend two live theatre productions offered by Case Western Reserve University's Department of Theater each semester. The students write critical essays about their experience as an audience member in relation to a particular aspect of the performance. Students also have an opportunity to complete in-class projects in which they gain experience functioning as a theatre practitioner. These projects and the accompanying written assignment are designed to increase the student's understanding of the function and interdependence of various theatre artists.
THTR 111. Introduction to Design. 3 Units.
This course offers the opportunity to learn, develop, and practice the art of set, costume, and lighting design by concentrates specifically on the processes, skills, and disciplines of design for performance. Furthermore, students will read several plays and examine ways in which theater design can suggest meaning and interpretation of the script. Students will learn basic design elements and principles of composition through interactive, collaborative projects and exercises in addition to critically analyzing other designers’ works from a broad spectrum of design styles. Emphasis will be placed on creativity, discovery, analysis, and collaboration.

THTR 185. Theater Practicum. 1 - 2 Units.
This Practicum is designed to provide students with hands-on experience in a variety of positions, both on stage and behind the scenes. Students will register for one credit-hour per semester unless directed otherwise by the Director of Undergraduate Theater Studies. Each student will meet with the Director of Undergraduate Theater Studies to determine his/her position for the semester. Credit will be awarded on a P/NP basis.

THTR 201. Movement for the Actor. 3 Units.
The course focuses on developing a kinesthetic awareness of the body and its use as a theatrically expressive instrument. Exercises will encompass development of flexibility, strength building, alignment, motor skills, and concentration. Prereq: THTR 101 or THTR 102.

THTR 206. Mr. Kiss Kiss Bang Bang - James Bond and Popular Culture. 3 Units.
The twenty-one films of James Bond have become part of popular culture, and the figure of the superspy has become mythic in proportion. This series, from its first installment in 1963 to the latest reinvention of James Bond in 2006, not only depicts one dashing man's efforts to save the world from disaster again and again, but also traces the development of our popular culture. Issues of violence, sex, the presentation and treatment of women, racial stereotypes, and spectacle among other topics can be discussed after viewing each film, providing an opportunity to explore the changing expectations of American audiences and the developing form of contemporary cinema. Students who have taken UOSS 286D may not receive credit for this class.

THTR 223. Scenic Design. 3 Units.
This course introduces scenic design techniques, approaches, and tools. Emphasis will be on developing ideas through script analysis, visual research, and analysis of the physical theater space, and finally, the communication of ideas through drafting and model building. Prereq: THTR 111 or requisites not met permission.

THTR 224. Lighting Design. 3 Units.
This course introduces lighting design techniques and approaches by combining theory with practical application. The basics of lighting instruments and control consoles are used for practical projects examining light on the stage. The design process is explored through script analysis, visual research, and choice of instrumentation, and communicated with the drafted light plot. Prereq: THTR 111 or requisites not met permission.

THTR 225. Costume Design. 3 Units.
This course is designed to introduce costume design techniques, approaches, and tools. Students will learn the process of costume design through application of skill and theories - from script analysis through post-production. In addition, students will participate in a survey of costume history and drawing/rendering skills will be taught. This course will culminate in a project designed to incorporate skills and techniques acquired during the semester. Prereq: THTR 111 or instructor permission.

THTR 226. Stage Makeup. 3 Units.
An introductory hands-on course in theatrical makeup techniques and tools. Students will study the history of stage makeup, its application, and the relationship between stage makeup and developing a character. The course will explore a variety of makeup applications from basic corrective makeup to special effects including prosthetics, crepe hair, and blood effects.

THTR 227. Stage Management. 3 Units.
Designed to acquaint student with the numerous aspects of stage management.

THTR 231. Acting III: Contemporary Technique. 3 Units.
An advanced exploration of contemporary acting technique emphasizing the effective use of poetic language, heightened partner awareness and behavioral response to achieve greater specificity and spontaneity in performance. Scene work will focus on American master playwrights of the 20th century such as Williams, Miller and Odets. Counts as SAGES Departmental Seminar. Prereq: THTR 103.

THTR 232. Acting IV: Classical Technique. 3 Units.
An exploration of techniques to approach classical theater, with emphasis on the works of Shakespeare. Presents the challenges of working with heightened language in classical texts, and provides skills necessary to transfer modern acting methods to these more poetic plays. Prereq: THTR 102.

THTR 301. Study Abroad at RADA: Dramatic Literature I. 3 Units.
This is a study-abroad course at the Royal Academy of Dramatic Arts in London. Theater 301 explores the foundations of theater in Western civilization, with a special emphasis on Greek theatre in performance. Acceptance into the RADA Study Abroad Program required. Students cannot receive credit for both THTR 228L and THTR 301.

THTR 302. Study Abroad at RADA: Dramatic Literature II. 3 Units.
This is a study-abroad course at the Royal Academy of Dramatic Arts in London. THTR 302 explores the many developments in playwriting, design, acting, and theater architecture in the French Neoclassic period. Acceptance into the RADA Study Abroad Program required. Student cannot receive credit for both THTR 229L and THTR 302.

THTR 303. Study Abroad at RADA: Acting Styles. 3 Units.
This is a study-abroad course at the Royal Academy of Dramatic Arts in London. THTR 303 is an exploration of techniques to approach classical theater, with emphasis on the works on Restoration theatre performance. Acceptance into the RADA Study Abroad Program required. Students cannot receive credit for both THTR 232L and THTR 303.

THTR 304. Study Abroad at RADA: Dramatic Literature III. 3 Units.
Course credit earned while studying abroad at the Royal Academy of Dramatic Arts in London. THTR 304 explores the work of Bertolt Brecht, with special emphasis on his play in performance. The course emphasizes the relationship between different theatrical representations and their historical and social context. Acceptance into the RADA Study Abroad Program required. Students cannot receive credit for both THTR 329L and THTR 304.

THTR 305. Study Abroad at RADA: Vocal Performance. 3 Units.
This is a study-abroad course at the Royal Academy of Dramatic Arts in London. THTR 305 focuses upon the training of the voice for heightened language. Acceptance into the RADA Study Abroad Program required. Students cannot receive credit for THTR 305 and either THTR 375L or THTR 376L.
THTR 306. Acting V: Camera Technique. 3 Units.
Acting for the Camera class with emphasis on how it differs from onstage work. Interviews, scenes, and exercises will be used to highlight the differences and similarities. Emphasis on contemporary works. Prereq: THTR 231 or THTR 232.

THTR 311. Audition Laboratory. 1 Unit.
A discussion and practicum exploring the problems faced by an actor in various audition situations. Development of an audition repertory for the actor for stage, video and film. Prereq: Senior Theater major.

THTR 312. Playwriting. 3 Units.
Theory and practice of dramatic writing, in the context of examples, classic and contemporary. Recommended preparation: ENGL 203 or ENGL 213 or ENGL 214 or ENGL 303 or ENGL 304. Offered as ENGL 305, THTR 312 and THTR 412.

THTR 314. Advanced Playwriting. 3 Units.
Theory and practice of dramatic writing with special focus on the craft of writing a full-length play. Offered as ENGL 314, THTR 314 and THTR 414. Prereq: ENGL 305 or THTR 312.

THTR 316. Screenwriting. 3 Units.
A critical exploration of the craft of writing for film, in which reading and practicum assignments will culminate in the student submitting an original full-length screenplay. Offered as ENGL 316, THTR 316 and THTR 416. Prereq: THTR 312 or ENGL 305 or THTR 412.

THTR 323. Topics in Design. 3 Units.
This course will examine various topics relating to theatre design and technology not covered in other design courses. Students will be provided with practical and theoretical knowledge on a specific topic in order to increase their design and/or technical skills. In addition, each course offering will have its own stated objectives. This course may be repeated by students with each new topic. Prereq: THTR 111 or instructor permission.

THTR 325. Development of Theater: Beginnings to English Renaissance. 3 Units.
This course explores the foundations of theater in Western civilization, beginning with Greece and then charting and analyzing the developments in playwriting, design, acting and theater architecture. Students read a wide variety of plays in order to obtain a comprehensive understanding of the history of the art form, but also learn how theater has played an integral societal function as a medium of political, economic, and cultural commentary. Development of Theater I explores developments from Aeschylus to the English Renaissance. Offered for undergraduates as THTR 325 and WLIT 360. Students who have taken THTR 228/WLIT 228 are not allowed to enroll in this course. Offered as THTR 325, WLIT 360, and THTR 425. Prereq: At least Sophomore standing.

THTR 326. Development of Theater: Renaissance to Romanticism. 3 Units.
This course explores the many developments in playwriting, design, acting, and theater architecture across the world. Students read a wide variety of plays in order to obtain a comprehensive understanding of the history of the art form, but also learn how theater has played an integral societal function as a medium of political, economic, and cultural commentary. Development of Theater II not only explores the development of theatrical conventions in Spain, England, Italy, France and other European countries that lead to the creation of modern drama, but the course also offers an in-depth look at the history and conventions of theater in India, Korea, China, and Japan. Offered as THTR 326, WLIT 361, and THTR 426. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: At least Sophomore standing.

THTR 327. American Drama. 3 Units.
Designed to provide students an overview of the development of theater in the United States and to familiarize them with the work and themes of selected American playwrights. Offered as THTR 327 and THTR 427.

THTR 329. Modern and Contemporary Drama. 3 Units.
This course explores the development of western drama and theatre from 1860 through present-day productions. The course emphasizes the relationship between different theatrical representations and their historical and social context. Shakespeare's well-known dictum that "theatre holds a mirror up to nature" is expanded when one examines who is holding that mirror, and how their actions participate in the constantly shifting construction of culture. Given this premise, the course investigates the development of specific European cultures (England, France, Germany, and Italy) as well as other regions (the United States, South America, and Russia) through the - live and literary - representations they make of themselves. Offered as THTR 329, WLIT 329 and THTR 429. Prereq: At least Sophomore standing.

THTR 330. Play Directing I. 3 Units.
This course will begin a two-semester study of the art and craft of stage direction of plays. Topics covered will include history of the profession, directorial theory and practice, development of skills such as text analysis, design and concept, and general problem solving. Offered as THTR 330 and THTR 430. Prereq: THTR 101 or THTR 102, and at least Junior standing.

THTR 331. Play Directing II. 3 Units.
This course will continue with the basic concepts learned in THTR 330 and will expand them in regard to actual production. Topics will include directing mechanics, ground planning, blocking, and visualization, staging and working with actors. The course will culminate in a faculty supervised directing project for public performance. There are three evening labs for this course. Offered as THTR 331 and THTR 431. Counts as SAGES Senior Capstone. Prereq: THTR 330, and at least Junior standing.

THTR 334. Shakespeare: Histories and Tragedies. 3 Units.
Close reading of a selection of Shakespeare's tragedies and history plays (e.g., "Richard the Third," "Julius Caesar," "Hamlet," "King Lear"). Topics of discussion may include Renaissance drama as a social institution, the nature of tragedy, national history, gender roles, sexual politics, the state and its opponents, theatrical conventions. Assessment may include opportunities for performance. A student may not receive credit for both ENGL 324 and ENGL 324C. Offered as ENGL 324, ENGL 424, and THTR 334. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

THTR 335. Shakespeare: Comedies and Romances. 3 Units.
Close reading of selected plays of Shakespeare in the genres of comedy and romance (e.g., "The Merchant of Venice," "Twelfth Night," "Measure for Measure," "The Tempest"). Topics of discussion may include issues of sexual desire, gender roles, marriage, the family, genre conventions. Assessment may include opportunities for performance. A student may not receive credit for both ENGL 325 and ENGL 325C. Offered as ENGL 325, ENGL 425, and THTR 335. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

THTR 375. Voice for the Stage I. 3 Units.
Development of the actor's vocal instrument. Work in articulation, range, and flexibility. Prereq: Theater major or consent of department.

THTR 376. Voice for the Stage II. 3 Units.
Continuation of THTR 375. Prereq: THTR 375.
THTR 382. Crossing Bridges: The Public Role of Artist in Understanding Disease. 3 Units.
An in-depth look at the role of the artist in public life and in creating theatrical performance from life experience. The students interact with patients in medical treatment for catastrophic illness and as they understand the experience of disease, they help transform that experience into a performance that gives a voice to the unvoiced in our society. The approved service learning course is offered only as a Senior Capstone and is a demanding challenge for the serious student of theater. Prereq: Acting concentration or consent of department. Counts as SAGES Senior Capstone.

THTR 385. Rehearsal and Production. 1 - 3 Units.
Practicum for students participating in production work in the Department of Theater and Dance. Supervised laboratory experience in technical theater, construction techniques, scenery, costumes, lighting, and props; production; ticket office operations, promotion, publicity and public relations; house management; wardrobe responsibilities; stage management; assistant directing; and other production positions relating to the mainstage performances in Eldred Theater. Students are recommended to take one credit hour per production, with a maximum of 8 credit hours allowed during their undergraduate career.

THTR 386. Rehearsal and Performance. 1 Unit.
Practicum for students participating in performance in the Department of Theater and Dance, relating to the mainstage productions at Eldred Theater. This course may be repeated, for a maximum total of 2 credits.

THTR 390. Advanced Topics in Design/Technology. 3 Units.
This is an advanced-level course designed to provide an opportunity for Design/Technical Theater Undergraduates to do an advanced project in scenic, costume, or lighting design, or in a technical area such as stage management or technical direction, as would be expected in the professional theater. This project may be a realized departmental production or an unrealized project. Working on a departmental production requires attendance at production meetings, technical rehearsals and other scheduled meetings. Counts as SAGES Senior Capstone. Prereq: THTR 111 and (THTR 223, THTR 224, THTR 225, or THTR 227) or requisites not met permission.

THTR 393. Senior Capstone: Dramaturgy. 3 Units.
This course introduces students to theories of textual analysis and contextual research within the framework of theatrical performance. Students will investigate the history and methodologies of dramaturgy, and then apply the best practices of the profession to the study and production of contemporary plays. Because dramaturgy is a collaborative endeavor, students will participate with others in the production of a theatrical adaptation from a non-dramatic source, as well as the creation of an interdisciplinary theatre event and a multi-media performance project. By course end, students will be able to support their theatrical interests with dramaturgical insights and to work collaboratively to create productions that reflect the cultural and aesthetic diversity of the 21st century. Counts as SAGES Senior Capstone. Prereq: THTR 401.

THTR 397. Honors Studies I. 3 Units.
Individual projects in acting, dance, and directing.

THTR 398. Honors Studies II. 3 Units.
Individual projects in acting, design, playwriting, and directing.

THTR 399. Independent Study in Theater Arts. 1 - 3 Units.
Independent research and project work in areas of acting, design, voice, theater history, playwriting, directing, or theater management.
THTR 425. Development of Theater: Beginnings to English Renaissance. 3 Units.
This course explores the foundations of theater in Western civilization, beginning with Greece and then charting and analyzing the developments in playwriting, design, acting and theater architecture. Students read a wide variety of plays in order to obtain a comprehensive understanding of the history of the art form, but also learn how theater has played an integral societal function as a medium of political, economic, and cultural commentary. Development of Theater I explores developments from Aeschylus to the English Renaissance. Offered for undergraduates as THTR 325 and WLIT 360. Students who have taken THTR 228/WLIT 228 are not allowed to enroll in this course. Offered as THTR 325, WLIT 360, and THTR 425. Prereq: Must be a student in M.A. Theater program.

THTR 426. Development of Theater: Renaissance to Romanticism. 3 Units.
This course explores the many developments in playwriting, design, acting, and theater architecture across the world. Students read a wide variety of plays in order to obtain a comprehensive understanding of the history of the art form, but also learn how theater has played an integral societal function as a medium of political, economic, and cultural commentary. Development of Theater II not only explores the development of theatrical conventions in Spain, England, Italy, France and other European countries that lead to the creation of modern drama, but the course also offers an in-depth look at the history and conventions of theater in India, Korea, China, and Japan. Offered as THTR 326, WLIT 361, and THTR 426. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Must be a student in M.A. Theater program.

THTR 427. American Drama. 3 Units.
Designed to provide students an overview of the development of theater in the United States and to familiarize them with the work and themes of selected American playwrights. Offered as THTR 327 and THTR 427. Prereq: Must be a student in M.A. Theater program.

THTR 429. Modern and Contemporary Drama. 3 Units.
This course explores the development of modern drama and theatre from 1860 through present-day productions. The course emphasizes the relationship between different theatrical representations and their historical and social context. Shakespeare’s well-known dictum that “theatre holds a mirror up to nature” is expanded when one examines who is holding that mirror, and how their actions participate in the constantly shifting construction of culture. Given this premise, the course investigates the development of specific European cultures (England, France, Germany, and Italy) as well as other regions (the United States, South America, and Russia) through the live and literary representations they make of themselves. Offered as THTR 329, WLIT 329 and THTR 429. Prereq: Must be a student in M.A. Theater program.

THTR 430. Play Directing I. 3 Units.
This course will begin a two-semester study of the art and craft of stage direction of plays. Topics covered will include history of the profession, directorial theory and practice, development of skills such as text analysis, design and concept, and general problem solving. Offered as THTR 330 and THTR 430. Prereq: Must be a student in M.A. Theater program.

THTR 431. Play Directing II. 3 Units.
This course will continue with the basic concepts learned in THTR 330 and will expand them in regard to actual production. Topics will include directing mechanics, ground planning, blocking, and visualization, staging and working with actors. The course will culminate in a faculty supervised directing project for public performance. There are three evening labs for this course. Offered as THTR 331 and THTR 431. Counts as SAGES Senior Capstone. Prereq: Must be a student in M.A. Theater program.

THTR 473. Graduate Voice Technique I. 3 Units.
Assessment of students’ current vocal and alignment skills. Laboratory for exploring new vocal and alignment habits supportive of healthy vocal functioning. Exploration of the body and voice as it relates to breath, resonance, and the healthy exhalation of sound. Prereq: Must be candidate in M.F.A. Acting program.

THTR 474. Graduate Voice Technique II. 3 Units.
Continued laboratory for the exploration of alignment and vocal skills supportive of healthy vocal functioning. Continued exploration of the body and voice as it relates to breath, articulation, resonance, and the healthy exhalation of sound. Emphasis on the physical and energetic skills needed to produce full-bodied, healthy sound capable of being heard and understood while acting in theatrical productions. Required of M.F.A. candidates in the Acting program. Prereq: THTR 473.

THTR 475. Graduate Voice Technique III: Classical Texts. 3 Units.
Development of skills needed to address the specific needs of Shakespeare and Classical texts in performance, including vocal skills, the use of breath, imagery, and textual studies. Prereq: THTR 474.

THTR 479. Graduate Stage Speech I: Phonetics. 2 Units.
Designed to evaluate the graduate student actors’ current speech skills, to teach them a stage appropriate dialect using the Skinner narrow IPA set, and to achieve a level of mastery over articulation and diction. Prereq: Must be a student in M.F.A. Acting program.

THTR 501. Text Analysis for the Actor. 2 Units.
An introduction to the craft of reading a theatrical text from an actor’s point of view. Methods for analyzing the action and dialogue of a play will be applied to dramatic text so that the actor can learn to transform a one-dimensional text into a three-dimensional performance. Prereq: Must be a student in M.F.A. Acting program.

THTR 509. Seminar: Performance Theory. 2 Units.
Research seminar designed to acquaint the student with selected major Western theoretical writings of performance theory and the art of the actor. Readings also include material on the creative acting process and the impact of societal and cultural influences on performance and the theatrical impulse. Prereq: Must be a student in M.F.A. Acting program.

THTR 512. Graduate Audition Lab. 1 - 2 Units.
This class focuses on choosing and developing classical and contemporary monologues for audition purposes. Other elements of the audition process are explored including the preparation of sides for a specific role as well as casting simulations with guest directors and instructors. Prereq: Must be a student in M.F.A. Acting program.

THTR 530. Ensemble Technique. 1 - 2 Units.
A practicum course structured to explore the use of ensemble dynamic techniques in a rehearsal/performance environment, as well as to develop a set of exercises which encourage and sustain the actor’s channels of interpersonal communication during a range of rehearsal and performance situations. Prereq: Must be a student in MFA Acting program.
THTR 531. Graduate Acting I: Performance Process. 3 Units.
This course is aimed toward developing a practical and cohesive acting approach. Through improvisations and structured exercises, the actor learns to employ the basic concepts of the Stanislavski System of intention, action and given circumstances in order to make acting decisions that are viable, playable, original, truthful and specific. Ensemble building and scene work also play heavily in this foundation course. Prereq: Must be a student in M.F.A. Acting program.

THTR 532. Graduate Acting II: Ensemble Improvisations. 3 Units.
Scene work will constitute the core of Acting II. Group improvisations and collective creations will be interspersed throughout the term. Fully embracing the idea of ensemble, this class will focus on exploration, where process and discovery are the primary objectives. Prereq: THTR 531.

THTR 533. Graduate Acting III: The Modernists. 3 Units.
The class focuses on the Modernists: Chekhov, Ibsen. The student will apply the Stanislavski System of character work and the specific tools of "Physical Acting" techniques to these playwrights through intensive scene work. The focus is also on imagery in language and clarity of subtext and imagery as it relates to the dramatic text and character intention. Prereq: THTR 532.

THTR 534. Graduate Acting IV: Shakespeare/Heightened Language. 3 Units.
This course explores the genre of theater loosely called "Heightened Language" and the challenges it presents for the actor. Students will complete intensive scene work on texts ranging from the Greeks, to Shakespeare, to the 19th Century Victorians, and discover the interconnectedness of the styles, and the demands they place on the actor's craft. Prereq: THTR 533.

THTR 540. Seminar: Professional Orientation. 2 Units.
This class is structured to help the third year MFA actor prepare for his/her entrance and transition to the professional arena. Students will be introduced to the world of contracts, taxes, agents and unions, and understand how to survive and thrive while pursuing a professional acting career. Guest speakers and facilitators will present material to familiarize students with the realities of a life in the arts. Prereq: Must be a student in M.F.A. Acting program.

THTR 579. Graduate Stage Speech II: Articulation. 3 Units.
This course will continue the work begun in THTR 479, exploring more of the International Phonetic Alphabet and developing applicable skills in articulatory sophistication. Prereq: THTR 479.

THTR 580. Graduate Stage Speech III: Dialects. 2 Units.
This survey course will examine the use and application of major stage dialects in the American theatre using a phonetic tool set as a basis for understanding sound substitutions. The student will also study the ways in which rhythmic changes and resonance and tension shifts affect the dialects. Prereq: THTR 579.

THTR 581. Graduate Stage Speech IV: Classical Texts. 2 Units.
The objective of this course is to increase and enhance the students' ability to handle the heightened language and technical demands of classical texts. The class will use poetry, first person narratives from classic novels and verse drama to accomplish this task. The class will contain a strong "verbal gym" component meant to strengthen and refine diction and standard American speech. Drills, tongue twisters, reading aloud will be part of every class. Prereq: THTR 580.

THTR 601. Special Projects. 1 - 3 Units.
(Credit as arranged.)

THTR 610. Professional Internship. 1 - 4 Units.
In the third year, the student will begin their Professional Internship with Cleveland Play House. Involvement will include: understudy assignments and an AEA contracted role in a production(s) as assigned by Cleveland Play House. Prereq: THTR 534.

THTR 630. Performance Studio. 3 Units.
A performance laboratory, ensemble-based practicum in which the student works to integrate effectively a wide range of performance skills culminating in a studio production. May be taken two times in the last two semesters of graduate study. Prereq: THTR 534.

THTR 642. Thesis Portfolio I. 1 Unit.
Course designed specifically for candidates in the Master of Fine Arts program in Acting. Graduate students enroll for the course during the fall semester of their third year of study. Work on the thesis spans three years of study based on roles the MFA actor has created. A rough draft of the thesis portfolio will be completed, according to requirements set forth in the department's MFA Handbook, and presented at the end of the fall semester of the third year to the faculty. Satisfactory completion of the portfolio is part of the requirements for awarding the Master of Fine Arts degree. Prereq: Must be a student in M.F.A. Acting program.

THTR 643. Thesis Portfolio II. 1 Unit.
Course designed specifically for candidates in the Master of Fine Arts program in Acting. Graduate students enroll for the course during the spring semester of their third-year of study. A finalized thesis portfolio containing an in-depth exploration of at least three roles is completed, according to requirements set forth in the department's MFA Handbook. This completed document is presented at the end of the spring semester of the third year. Satisfactory completion of the portfolio is part of the requirements for awarding the Master of Fine Arts degree. Prereq: THTR 642 and must be a student in MFA Acting program.

THTR 644. M.A. Project. 1 - 12 Units.
Research and development of a Master of Arts project in Theater.

Washington Study Program
111 Mather House
http://politicalscience.case.edu/undergraduate-programs/washington-center-program/
Phone: 216.368.2646; Fax: 216.368.4681
Justin Buchler, Program Director
justin.buchler@case.edu

The Washington Study Program provides students with the opportunity to complete a full-time, research-intensive internship in Washington, D.C. By participating in a semester-length program during the fall or spring (WASH 2A Washington Center Internship), students earn 9 credit hours; for a summer internship (WASH 2D Washington Center Summer Internship), they earn 3 credit hours. In addition, students earn 3 credit hours by developing a portfolio based on their internship experiences (WASH 2C Washington Center - Portfolio). The credits earned can be counted as general electives or applied to a student's major or minor, with the prior consent of the individual department(s). Finally, as part of the Washington Study Program, students participate in a seminar and attend a weekly lecture/discussion group (WASH 2B Washington Center - Politics and Public Policy Course).

To be eligible for the program, a student is expected to be a junior or senior and have at least a 3.0 GPA. The program director, the student’s major advisor, and the appropriate dean must approve each application.
Students must ensure that their participation will not prevent them from meeting on-campus residency or other university requirements.

**Women's and Gender Studies Program**

www.case.edu/artsci/womn
Phone: 216.368.2233
Cheryl Toman, Director
cheryl.toman@case.edu

The goal of the Women’s and Gender Studies Program is to educate students in interdisciplinary approaches to feminist theories of women, gender, culture, and society. Students are exposed to a variety of forms of critical thinking in relation to:

1. the social construction of knowledge and philosophy
2. approaches to science and medicine informed by “feminist empiricism” and “feminist standpoint” theories
3. historicized and cross-cultural accounts of gender and gender inequality
4. literary criticism
5. contemporary theories of art, performance, language, jurisprudence, social science, and religion in the context of women’s experience
6. studies of the body as a focal point for theorizing relations among the arts and sciences

Women’s and Gender Studies is an interdisciplinary program that prepares students to think critically and creatively within a framework employing gender as a central category of analysis. The program is set up to test and challenge the technologies and limitations of gender roles in a multitude of cultural and historical settings. It is designed to familiarize students with the analytical and hermeneutic tools of research and interpretation, and to create awareness of the ethical, political, and aesthetic dimensions of gender in history and culture.

**Undergraduate Program**

**Major**

The Women’s and Gender Studies Program offers a major leading to the Bachelor of Arts degree. The program offers a sound course of study with a disciplinary concentration grounding the program’s interdisciplinary objectives. Up to six credit hours in required or elective courses for another major may also be applied to the Women’s and Gender Studies major.

In the two required courses, students become fluent in current tools of research and interpretation employed in women’s and gender studies.

**Required Course I:**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tr>
<td>WGST 201</td>
<td>Introduction to Gender Studies</td>
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<td>HSTY 270/ENGL/PHIL/RLGN 270</td>
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**Required Course 2: One of the following:**

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<td>WGST 301</td>
<td>Women, Creativity and the Arts</td>
<td>3</td>
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<tr>
<td>WGST 318</td>
<td>History of Black Women in the U.S.</td>
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<td>WGST 326</td>
<td>Gender, Inequality, and Globalization</td>
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<td>Women in American History I</td>
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<td>WGST 354</td>
<td>Women in American History II</td>
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</tbody>
</table>

**Minor**

Fulfillment of the minor requires completion of 18 credit hours according to the following course distribution:

**Required Courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>WGST 201</td>
<td>Introduction to Gender Studies</td>
<td>3</td>
</tr>
</tbody>
</table>

**Five approved electives**

**Total Units**

24

To help ensure a comprehensive course of study in a particular area of interest, each student’s combination of courses and the structure of an independent study must be approved by one of the program’s academic representatives.

**Program Faculty**

Cheryl Toman, PhD
Professor, Department of Modern Languages and Literatures; Director and Academic Representative, Women's and Gender Studies Program

Karen Beckwith, PhD
*Flora Stone Mather Professor, Department of Political Science*

Joy Bostic, PhD
Associate Professor, Department of Religious Studies

Susan S. Case, PhD
Associate Professor, Department of Organizational Behavior, Weatherhead School of Management

Margaretmary Daley, PhD
Associate Professor, Department of Modern Languages and Literatures

Ananya Dasgupta, PhD
Assistant Professor, Department of Modern Languages and Literatures

T. Kenny Fountain, PhD
Assistant Professor, Department of History

Elina Gertsman, PhD
Professor, Department of English

Laura E. Hengehold, PhD
Associate Professor, Department of Philosophy

Susan W. Hinze, PhD
Associate Professor, Department of Sociology

Justine Howe, PhD
Assistant Professor, Department of Religious Studies
WGST 227. Women, Gender, and Islam. 3 Units.
Women and gender are central to understanding Muslim societies, past and present. From debates about the veil to the wars in Iraq and Afghanistan, gendered concerns have been especially prominent in contemporary debates about the status of Islam in the modern world. How have Muslim thinkers interpreted Islamic scriptures with respect to topics such as marriage, child custody, inheritance, and sexuality? How is masculinity and femininity constructed? In what ways do their interpretations reflect the political, economic, and social conditions in which they lived? How does gender structure authority and power in Muslim communities? How and why have Muslim women become so important in contemporary debates over religious and national identity around the world? This course begins by examining the position of women and gender in the foundational Islamic texts, the Qur’an and Sunna (the practice of the Prophet Muhammad), and pre-modern interpretations of them. Then we will explore marriage and divorce in Muslim jurisprudence, in order to examine themes such as women’s spiritual capacities, female leadership, sexuality, and slavery. Next, we will turn to the headscarf as a lens through which to explore modern configurations of gender and sexuality, as they intersect with conceptions of national belonging, religious identity, and individual freedom. Finally, we will study contemporary debates over polygyny, homosexuality, and female religious authority. There are no prerequisites for this course. Offered as RLGN 227 and WGST 227. Counts for CAS Global & Cultural Diversity Requirement.

WGST 228. Sociology of Sexuality. 3 Units.
This course analyzes the issues of sex and sexuality from a sociological point of view. It is centered on the notion that what we consider to be ‘normal’ or ‘natural’ about sex and sexuality is, in reality, socially constructed. One’s viewpoint on the issues surrounding sexuality are influenced by the social context in which they live, as opposed to the purely biological viewpoint that presupposes some sense of normalcy or naturalness regarding sexual relations. A range of topics will be covered, including readings that discuss the variations of sexuality and the notions of sexual “deviance” in order to explore the cultural and societal variation that exists along the lines of gender, race, ethnicity, sexual orientation, age and disability. Offered as SOCI 228 and WGST 228.

WGST 257. Women’s Histories in South Asia. 3 Units.
This course traces the history of women in South Asia from pre-colonial times to the present. Themes explored in the course will include (but not be limited to): the historical transformations of institutions shaping women’s lives such as state, family, religious and legal traditions; the impact of colonialism, nationalism, and decolonization on women, as well as the history of women’s movements in various parts of South Asia. As we acquaint ourselves with the vibrant historiography on women in South Asia, we will also examine the theoretical and methodological challenges involved in writing histories using the analytical lens of gender. While a significant portion of the readings will focus on South Asia, we will occasionally bring in insights from histories of women in other parts of the world to help develop comparative perspectives and evaluate the South Asian cases and examples within the broader field of women’s history. Offered as HSTY 157 and WGST 257. Counts for CAS Global & Cultural Diversity Requirement.

WGST 268. Women in the Bible: Ethnographic Approaches to Rite and Ritual, Story, Song, and Art. 3 Units.
Examination of women in Jewish and Christian Biblical texts, along with their Jewish, Christian (and occasionally Muslim) interpretations. Discussion of how these traditions have shaped images of, and attitudes toward, women in western civilization. Offered as RLGN 268, WGST 268, and JDST 268.
WGST 301. Women, Creativity and the Arts. 3 Units.
In this course, students will focus on two areas of study: a) women and creativity and b) women and activism through the arts. A history of women in the arts will be covered, but the general focus of the course is on women in the arts since the 1960s in particular, and on artwork that reflects or provokes social change. “Arts” are defined in the broadest of sense. That is, students will study women’s production in painting, photography, graphic design, sculpture, dance, film, music, and theater. A variety of learning techniques will be applied: Students will look at feminist theories on art, be introduced to the notion of cyberfeminism, study actual artwork and its reproductions, understand the role of art in feminist activism and how women “create” differently from men, and work closely with several feminist artists/activists through various programs on campus and the community in order to facilitate the planning and carrying out of artistic production. Subsequently, students will interact with children in Cleveland schools in conjunction with these artists giving master classes, and be exposed to art exhibits abroad through videocferencing with the Algerian Cultural Center in Paris and locally through University Circle Institutions. Offered as WGST 301 and ETHS 301. Counts for CAS Global & Cultural Diversity Requirement.

WGST 302. The Lemonade Class: Religion, Race, Sex and Black Music. 3 Units.
Charles Long suggests that black musical forms are creative responses to the particular circumstances of black peoples’ presence in the U.S. and black notions of the sacred. In April of 2016, Beyoncé released her visual album two days after the death of Prince. This course is organized around the album’s title cuts and links these two artists together in an examination of religion and musical performance as creative response to the racial and gendered conditions of black life. The course investigates how both artists have used music as a platform to explore issues of race, gender, commerce, sexuality, power and divinity. The course also looks at examples from the works of earlier artists who address similar themes such as Ma Rainey, Bessie Smith, Muddy Waters, Billie Holiday, Nina Simone, Little Richard, Marvin Gaye, and Aretha Franklin. Offered as ETHS 302, MUHI 316, RLGN 402, and WGST 302. Counts for CAS Global & Cultural Diversity Requirement.

WGST 304. Representations of Black Women and Religion in Film. 3 Units.
In this course we will explore cinematic representations of black women and religion in film. Each week we will view a film in class. We will begin the class with the film Imitation of Life and then the course with The Help. Throughout the course we will analyze the ways in which notations of gender, sexuality, intimate violence, and modern notions of race and color, have informed representations of black women and religion in film. In addition, we will discuss how these representations, in turn, have influenced cultural ideas about black women in the Americas. Offered as RLGN 304, RLGN 404, WGST 304, and ETHS 304. Counts for CAS Global & Cultural Diversity Requirement.

WGST 312. Women in the Ancient World. 3 Units.
The course offers a chronological survey of women’s lives in Greece, Hellenistic Egypt, and Rome. It focuses on primary sources as well as scholarly interpretations of the ancient record with a view to defining the construction of gender and sexuality according to the Greco-Roman model. Additionally, the course aims to demonstrate how various methodological approaches have yielded significant insights into our own perception of sex and gender. Specific topics include matriarchy and patriarchy; the antagonism between male and female in myth; the legal, social, economic, and political status of women; the ancient family; women’s role in religion and cult; ancient theories of medicine regarding women; pederasty and homosexuality. Offered as CLSC 312 and WGST 312. Counts for CAS Global & Cultural Diversity Requirement.

WGST 315A. International Bioethics Policy and Practice: Women’s Health in the Netherlands. 3 Units.
This 3-credit course allows students to familiarize themselves with social policies and practices related to women’s health in the United States and the Netherlands. Issues covered in the course include birth control and family planning, abortion, prenatal testing, childbirth, health care disparities, cosmetic surgery, prostitution and trafficking in women. This course also addresses the US and Dutch national policies regarding the public provision of health care for women. The course places an emphasis on the ways in which social norms shape policies over time, which political actors are involved in shaping women’s health policy, and the balance between women’s health as a matter of the public good or individual responsibility. This course substantively explores gender-specific cultural values and practices in relation to women’s health in the United States and the Netherlands and will help students develop the analytical skills necessary for evaluating social policy and ethical issues related to women’s health. Offered as BETH 315A and BETH 415A. Counts for CAS Global & Cultural Diversity Requirement.

WGST 318. History of Black Women in the U.S.. 3 Units.
Chronologically arranged around specific issues in black women’s history organizations, participation in community and political movements, labor experiences, and expressive culture. The course will use a variety of materials, including autobiography, literature, music, and film. Offered as ETHS 318, HSTY 318, and WGST 318.

WGST 325. Philosophy of Feminism. 3 Units.

WGST 326. Gender, Inequality, and Globalization. 3 Units.
Using a sociological perspective, this course examines how major societal institutions, including the economy, polity, medicine, religion, education and family, are structured to reproduce gendered inequalities across the globe. Attention is given to the intersections of race/ethnicity, social class, gender and sexuality in social systems of power and privilege. Of critical importance is how gender figures in the relationship between Economic North and Economic South countries. We will elucidate how gender norms vary by culture and exert profound influence on the daily, lived experiences of women and men. The course will be informed by recent scholarship on feminism, women’s movements, and globalization. Offered as SOCI 326 and WGST 326. Counts for CAS Global & Cultural Diversity Requirement. Prereq: SOCI 101 or permission of program director.
WGST 335. Women in Developing Countries. 3 Units.
This course will feature case studies, theory, and literature of current issues concerning women in developing countries primarily of the French-speaking world. Discussion and research topics include matriarchal traditions and FGM in Africa, the Tunisian feminist movement, women, Islam, and tradition in the Middle East, women-centered power structures in India (Kerala, Pondichery), and poverty and women in Vietnam, Laos, and Cambodia. Guest speakers and special projects are important elements of the course. Seminar-style format, taught in English, with significant disciplinary writing in English for WGST, ETHS, and some WLIT students, and writing in French for FRCH and WLIT students. Writing assignments include two shorter essays and a substantial research paper. Offered as ETHS 335, FRCH 335, WLIT 335, WGST 335, FRCH 435 and WLIT 435. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

WGST 337. Women in the Arab World. 3 Units.
The purpose of this course is twofold: It is a course that allows students an in-depth look at the diverse women who represent a number of cultures in the Arab world in nations from the Mashrek to the Maghreb. The second primary goal of the course is to study such women through the eyes of leading Arab women theorists who have made an impact not only in their own countries, but also on disciplines intersecting with women's studies worldwide. We will study the Arab woman's place in her respective society, in political and economic systems, in education, and in the family. We will also analyze her contributions to art and literature as well as to the sciences. The course will provide an overview of the Arab woman throughout history, from her origins to her place within recent movements within the Arab Spring and other current world events. As Arab women are Muslim, Christian, and Jewish, views of women within these major world religions will also be taken into account as we study the Arab woman as well as religion's impact on culture in the Middle East and in the Maghreb in particular. In the course, we will utilize theoretical texts, but also case studies as well as examples from media and the arts. During the semester, we will take advantage of teleconferencing opportunities between CWRU and two major academic units for Women's Studies in the Arab world: The Institute for Women's Studies in the Arab World (IWSAW) in Beirut, Lebanon, and the University of Jordan's Center for Women's Studies in Amman. Offered as FRCH 337, FRCH 437, ARAB 337, ETHS 337 and WGST 337. Counts for CAS Global & Cultural Diversity Requirement.

WGST 339. Black Women and Religion. 3 Units.
This course is an exploration of the multidimensional religious experiences of black women in the United States. These experiences will be examined within particular historical periods and across diverse social and cultural contexts. Course topics and themes include black women and slave religion, spirituality and folk beliefs, religion and feminist/womanist discourse, perspectives on institutional roles, religion and activism, and spirituality and the arts. Offered as ETHS 339, RLGN 338 and WGST 339. Counts for CAS Global & Cultural Diversity Requirement.

WGST 342. Latin American Feminist Voices. 3 Units.
Examination of the awakening of feminine and feminist consciousness in the literary production of Latin American women writers, particularly from the 1920s to the present. Close attention paid to the dominant themes of love and dependency; imagination as evasion; alienation and rebellion; sexuality and power; the search for identity and the self-preservation of subjectivity. Readings include prose, poetry, and dramatic texts of female Latin American writers contributing to the emerging of feminist ideologies and the mapping of feminist identities. Offered as SPAN 342, SPAN 442, ETHS 342, WGST 342, WLIT 342, and WLIT 442.

WGST 343. Language and Gender. 3 Units.
This course introduces students to the study of language and gender by exploring historical and theoretical trends, methods, and research findings on the ways gender, sexuality, language, and discourse interact with and even shape each other. Topics may include "grammatical" versus "biological" gender, feminine escriture, the women and language debate, speech acts and queer performativity, nonsexist language policy, discourses of gender and sexuality, feminist stylistics, and LGBT sociolinguistics. Offered as ENGL 343, ENGL 443, and WGST 343. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

WGST 345. Topics in LGBT Studies. 3 Units.
This course will focus on selected topics in the study of LGBT literature, film, theory, and culture. Individual courses may focus on such topics as queer theory, LGBT literature, queer cinema, gay and lesbian poetry, LGBT graphic novels, the AIDS memoir, AIDS/Gay Drama, and queer rhetoric and protest. Maximum 6 credits. Offered as ENGL 345, ENGL 445 and WGST 345. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

WGST 346. Women and Politics. 3 Units.
Women and Politics involves a critical examination of the impact of gender on the forms and distributions of power and politics, with primary reference to the experience of women in the United States. Major concerns of the course include what we mean by "sex," "gender," and "politics;" the relationship between women and the state; how women organize collectively to influence state policies; and how the state facilitates and constrains women's access to and exercise of political power. The course is organized around four foci central to the study of women and politics. The first section of the course focuses on what we mean by "women;" "gender;" and "politics." In this section, we will consider how these concepts intersect and the ways in which each may be used to deepen our understanding of the workings of governments and political systems, and of women's relative political powerlessness. The second section of the course employs these concepts to understand the (re) emergence of the US feminist movement, its meanings, practices, and goals, and its transformation across US political history. In the third section, we turn to conventional electoral politics, focusing on women's candidacies, their campaigns, and women's voting behavior. In the final section of the course, we consider those general factors that might provide for increased gender equality and improved life status for women, in global, comparative perspective. Offered as POSC 346, POSC 446 and WGST 346. Counts as SAGES Departmental Seminar.
WGST 349. The Arab World Experience. 3 Units.
Taught and led by Case faculty, The Arab World Experience is a spring semester course with a spring break study abroad component in a Middle Eastern or North African country supplemented by course meetings before and after travel. It will rotate among countries such as Jordan, Lebanon, Morocco, etc. and be taught by faculty with appropriate area expertise in Arabic, Women’s and Gender Studies, and/or Ethnic Studies. The course focuses on topics such as history, politics, culture, and gender relations within the society of study. Workload and learning outcomes are commensurate with a semester-long three credit hour course. Guest lectures in the host country are an important component of the course as they bring a fresh, authentic perspective to the aforementioned topics discussed. There will be three three-hour meetings prior to travel, required reading, and one three-hour meeting after travel. In the host country, students will spend seven days (five-eight hours per day) in seminars, discussions, and site visits. Student grades are determined on the basis of participation, attendance, a daily experiential learning journal, interviews with guest speakers, and a final exam. Offered as ARAB 349, ETHS 349 and WGST 349. Counts for CAS Global & Cultural Diversity Requirement.

WGST 352. African Feminisms. 3 Units.
This course traces the history of African feminism from its origins within traditions through to a more contemporary theoretical analysis of gender, marriage, and motherhood seen from an Afrocentric perspective. Approaches studied are those that pertain to anthropology, history, literature, sociology, and culture. African feminist theory of scholars such as Filomina Steady, Cheikh Anta Diop, Buchi Emecheta, Ifi Amadiume, Obioma Nnameka, Oyeronko Oyewumi, and Calixthe Beyala will be studied and there will be some comparative analysis of Western theories to show how African feminisms are clearly distinct. Theories on these feminisms will be presented, and in the process, students will look at cases of women in Cameroon, Nigeria, Ghana, Kenya, and Senegal. It is commonly believed that African women were defined for a long time according to constructs of Western anthropology. This course will thus look at social institutions such as woman-to-woman marriage, matriarchy, and various women’s rituals in order to identify African constructs of gender, family, kinship, marriage, and motherhood. Offered as ETHS 352 and WGST 352. Counts for CAS Global & Cultural Diversity Requirement.

WGST 353. Women in American History I. 3 Units.
The images and realities of women’s social, political, and economic lives in early America. Uses primary documents and biographers to observe individuals and groups of women in relation to legal, religious, and social restrictions. Offered as HSTY 353, WGST 353, and HSTY 453. Counts for CAS Global & Cultural Diversity Requirement.

WGST 354. Women in American History II. 3 Units.
With HSTY 353, forms a two-semester introduction to women’s studies. The politics of suffrage and the modern woman’s efforts to balance marriage, motherhood, and career. (HSTY 353 not a prerequisite.) Offered as HSTY 354, WGST 354, and HSTY 454. Counts for CAS Global & Cultural Diversity Requirement.

WGST 359. Visual Culture of Medieval Women. 3 Units.
This course will consider the roles of women as patrons, subjects, producers and consumers of visual culture, focusing particularly on the twelfth through fifteenth centuries. Throughout the course, we will study the different ways medieval men and women perceived, read, figured, and interacted with the female body, which was frequently seen as a fraught site of desire and repulsion, fear and fascination. Students will be asked to read primary sources as well as critical materials that address contradictory constructions of gender and sex in medieval images and texts. The course, therefore, will not simply focus on artistic production, but will include readings and discussions of social and political history, theology, and literature of the Middle Ages. Offered as ARTH 359 and ARTH 459; cross-listed as WGST 359 since it focuses on the role of women in visual culture and so can satisfy a requirement in the program for the course on women in the arts. Offered as ARTH 359, ARTH 459 and WGST 359. Counts for CAS Global & Cultural Diversity Requirement.

WGST 360. Global Politics of Fertility, Family Planning, and Population Control. 3 Units.
This course offers an anthropological examination of fertility behaviors around the world. In particular, it explores various historical, cultural, socioeconomic, political, and technological factors contributing to reproductive activities. After introducing the anthropological approaches to the study of fertility, the course will delve into the ways to regulate fertility in historical and contemporary times, various factors contributing to fertility change, state intervention in reproduction through voluntary and coercive family planning programs, and new reproductive technologies and ethical concerns surrounding assisted reproduction and abortion. Offered as ANTH 360, ANTH 460 and WGST 360.

WGST 363. Gender and Sexuality in America. 3 Units.
This multicultural seminar uses a mixture of historical text, gender theory, personal biography, and artistic expression to explore changing notions of gender and sexuality over the past two centuries in the United States. Offered as HSTY 363, HSTY 463 and WGST 363. Counts for CAS Global & Cultural Diversity Requirement.

WGST 365. Gender and Sex Differences: Cross-cultural Perspective. 3 Units.
Gender roles and sex differences throughout the life cycle considered from a cross-cultural perspective. Major approaches to explaining sex roles discussed in light of information from both Western and non-Western cultures. Offered as ANTH 365, ANTH 465 and WGST 365.

WGST 370. Women and Men as Colleagues in Organizations. 3 Units.
The purpose of this course is to prepare students to succeed in the workforce by understanding and exploring the opportunities and challenges of work across the lifespan and developing necessary skills to be effective. The course broadens understanding of gender dynamics and gendered structures in the workplace, intersections of gender with other identities, and the leadership and managerial issues affecting women and men in work organizations. The course helps students create a personal framework for how to develop a successful, happy and integrated work life in the global economy. Offered as ORBH 370 and WGST 370. Counts for CAS Global & Cultural Diversity Requirement.

WGST 372. Work and Family: U.S. and Abroad. 3 Units.
Covers the impact on human lives of the interface between work and family; the different ways gender structures the experience of work and family depending upon racial and ethnic background, social class, age, and partner preference; the impact of historical context on work-family experiences; work-family policies in the United States and other countries. Offered as SOCI 372, WGST 372, and SOCI 472.
The World Literature Program offers a major leading to the Bachelor of Arts degree. Requirements for the major are as follows:

**Required Courses:**

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>WLIT 211</td>
<td>World Literature I</td>
<td>3</td>
</tr>
<tr>
<td>WLIT 212</td>
<td>World Literature II</td>
<td>3</td>
</tr>
<tr>
<td>WLIT 390</td>
<td>Topics in World Literature</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 290</td>
<td>Masterpieces of Continental Fiction</td>
<td>3</td>
</tr>
<tr>
<td>One of the following:</td>
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<tr>
<td>WLIT/CLSC 203</td>
<td>Gods and Heroes in Greek Literature</td>
<td>3</td>
</tr>
<tr>
<td>WLIT/CLSC 204</td>
<td>Heroes and Hustlers in Roman Literature</td>
<td></td>
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<tr>
<td>ENGL/WLIT 387</td>
<td>Literary and Critical Theory</td>
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</tbody>
</table>

Two courses in literature at the 300 level in a language other than English: 6

Twelve hours of electives: 12

Total Units: 33

All literature courses at the 200 and 300 levels offered by the Departments of Modern Languages and Literatures, Classics, and English are approved as world literature courses.

**Undergraduate Honors**

The honors program in world literature is for especially talented and dedicated majors. Requirements for honors are: 1) a GPA of at least 3.5 in the major, and 2) an honors thesis completed over the course of two semesters in the senior year, devoted to the investigation of a literary or cultural topic. Honors students enroll in WLIT 397 Honors Thesis I and WLIT 398 Honors Thesis II and write their thesis under the supervision of a WLIT faculty advisor. The thesis must be approved by a second faculty member and receive a grade of B or better. Students who qualify receive their degrees "with Honors in World Literature." A registration/proposal...
form for students electing honors must be completed by the end of the second week of classes in each of the two semesters.

**Minor**
The minor in world literature requires:

**Required Courses:**

<table>
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<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>WLIT 211</td>
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<tr>
<td>WLIT 212</td>
<td>World Literature II</td>
<td>3</td>
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</tbody>
</table>

Nine credits of electives chosen in consultation with a program advisor

Total Units: 15

**BA in Classics: Classical Tradition Concentration**
Students interested in world literature may also be interested in the Classical Tradition Concentration, one of three tracks for a BA in Classics. For course information, please visit the Department of Classics page (p. 267).

**Graduate Program**
The World Literature Program offers a master of arts degree. Students pursuing the MA take courses that investigate visual arts, film, and music as well as literature, reflecting a belief that literature and the arts are in permanent dialogue. The program takes an interdisciplinary perspective in which cultural history and aesthetic history coexist.

Along with the Department of Classics, which hosts the program, World Literature is associated with other departments in the College of Arts and Sciences, including cognitive science, modern languages and literatures, philosophy, history, and religious studies.

The program offers tuition waivers and teaching assistant stipends to qualified students.

**Program Director**
Florin Berindeanu, PhD
Instructor, Department of Classics; Director, World Literature Program

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**Steering Committee**
Sarah Gridley, MFA
Associate Professor, Department of English

Takao Hagiwara, PhD
Associate Professor, Department of Modern Languages and Literatures

William Siebenschuh, PhD
Oviatt Professor of English, Department of English

Timothy Wutrich, PhD
Senior Instructor, Department of Classics

**Courses**

**WLIT 201. Greek Prose Authors. 3 Units.**
Readings from authors such as Plato, Lysias, Xenophon, and Herodotus. Offered as GREK 201, GREK 401, WLIT 201 and WLIT 401.

**WLIT 202. Introduction to Greek Poetry. 3 Units.**
Primarily readings from Homer, Hesiod, and Theocritus. Selections from Greek lyric may be introduced at the instructor’s discretion. Offered as GREK 202, GREK 402, WLIT 202, and WLIT 402.

**WLIT 203. Gods and Heroes in Greek Literature. 3 Units.**
This course examines major works of Greek literature and sets them in their historical and cultural context. Constant themes are war, wandering, tyranny, freedom, community, family, and the role of men and women within the household and the ancient city-state. Parallels with modern life and politics will be explored. Lectures and discussions. Offered as CLSC 203 and WLIT 203. Counts for CAS Global & Cultural Diversity Requirement.

**WLIT 204. Heroes and Hustlers in Roman Literature. 3 Units.**
This course constitutes the second half of a sequence on Classical literature. Its main themes are heroism vs. self-promotion, love vs. lust, and the struggle between democracy and tyranny. These topics are traced in a variety of literary genres from the period of the Roman republic well into the empire. Parallels with modern life and politics will be drawn. Offered as CLSC 204 and WLIT 204. Counts for CAS Global & Cultural Diversity Requirement.

**WLIT 205. Readings from the Epic of Gilgamesh. 3 Units.**
In this course, we will read the entire Standard Babylonian recension of the Epic of Gilgamesh, considered the first great work of literature, from the original Akkadian text. While the primary goal of the course will be to become proficient readers of Akkadian, we will take some excursus on topics such as Babylonian religion, whether Gilgamesh was a historical figure or not, how the text was put together, and its possible influence on later heroic traditions such as the Greco-Roman. Offered as AKKD 205, AKKD 405, WLIT 205 and WLIT 405. Counts for CAS Global & Cultural Diversity Requirement. Prereq: AKKD 101 and AKKD 102.

**WLIT 211. World Literature I. 3 Units.**
Survey of literature from antiquity to 1600. May include Western and non-Western texts by Homer, Vergil, Ovid, St. Augustine, Dante, Boccaccio, Rabelais, Cervantes, Sei Shonagon, Basho, and the Baghavad Gita.

**WLIT 212. World Literature II. 3 Units.**
Survey of literature from 1600 to present. May include Western and non-Western texts by Swift, Voltaire, Rousseau, Tolstoi, Baudelaire, Austen, Mann, Kafka, Lispector, Marmon Silko, Soyinka.

**WLIT 220. Art & Literature in the Classical Tradition, Pt 1: Renaissance and Baroque (14th to 17th centuries). 3 Units.**
Through lectures, varied assignments, and visits to the Cleveland Museum of Art this course will introduce students to the major issues in the study of early modern art and literatures. The emphasis will inevitably be on Italy, as the place where the physical remains of ancient Rome confronted and inspired such remarkable masters as Michelangelo (as poet and artist), Palladio, Gian Lorenzo Bernini, Nicholas Poussin (Bernini and Poussin are represented in the CMAI), though some artists -- notably Leonardo -- resisted the lure of the classical past. From Italy new ideas spread to the rest of Europe and beyond. We will not have much time to study Shakespeare in the course, but we will not be able to ignore the greatest author of the Renaissance period. Like Shakespeare, we will move between the court and the city, between scenes of often-endangered order and scenes of sometimes-productive disorder, in which classical models provided a key cultural and even psychological resource in challenging times. Recommended preparation: CLSC 232. Offered as CLSC 220 and WLIT 220. Counts for CAS Global & Cultural Diversity Requirement.
WLIT 222. Classical Tradition 2: Birth of Archaeology. 3 Units.
The course will focus on the history of diverse methods for studying societies remote in time and space; i.e., on the formation of the distinct disciplines of archaeology and anthropology, and the interest in the origins of human society and cultural practices. The birth of archaeology occurred in the context of the profound transformation of European cultural life in the eighteenth century, the era of the Enlightenment. On the basis of a range of cultural productions (literary and historical texts, objects of luxury and use, etc.), we will study visual and literary works and consider the relationship between different modes of artistic production and expression, as well as the marketing and display of prestigious objects, whether ancient or modern. We will consider the eighteenth-century model of experiential education, the “Grand Tour,” and the formation of private and public collections, as well as the emergence of the museum as institution. Finally, we will also consider important recent work on the relationship between the production of luxury commodities (sugar, coffee, tea, etc.) through the plantation economy in the Americas and beyond and the development of attitudes and ideas in Europe. Offered as CLSC 222 and WLIT 222. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 224. Sword and Sandal: The Classics in Film. 3 Units.
Gladiator. Alexander. The 300. Contemporary society’s continuing fascination with putting the ancient world on the big screen is undeniable; and yet the causes underlying this phenomenon are not quite so readily apparent. In this course we will watch and discuss a number of movies about the ancient world, running the gamut from Hollywood classics such as Ben-Hur and Spartacus to more recent treatments (the aforementioned 300 and Gladiator, for starters), and from the mainstream and conventional (Clash of the Titans, Disney’s Hercules) to the far-out and avant-garde (Fellini’s Satyricon, anyone?). As we do so we’ll learn quite a bit about the art and economics of film, on one hand, and the ancient world, on the other. And yet what we’ll keep coming back to are the big questions: what does our fascination with the ancient Mediterranean tell us about ourselves as a society? Why do such movies get made, and what kinds of agendas do they serve? To what extent can we recapture the past accurately? And if we can’t, are we doomed to just endlessly projecting our own concerns and desires onto a screen, and dressing them in togas? No knowledge of ancient languages is required for this course. Offered as CLSC 224 and WLIT 224.

WLIT 225. Japanese Popular Culture. 3 Units.
This course highlights salient aspects of modern Japanese popular culture as expressed in animation, comics and literature. The works examined include films by Hayao Miyazaki, writings by Kenji Miyazawa, Haruki Murakami, and Banana Yoshimoto, among others. The course introduces students to essential aspects of modern Japanese popular culture and sensibility. Offered as JAPN 225 and WLIT 225. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 232. Vergil. 3 Units.
Primarily readings from The Aeneid; selections from Vergil’s other work may be introduced at instructor’s discretion. Recommended preparation: LATN 201 or equivalent. Offered as LATN 202, LATN 402, WLIT 232 and WLIT 432.

WLIT 235. Asian Cinema and Drama. 3 Units.
Introduction to major Asian film directors and major traditional theatrical schools of India, Java/Bali, China, and Japan. Focus on the influence of traditional dramatic forms on contemporary film directors. Development of skills in cross-cultural analysis and comparative aesthetics. Offered as ASIA 235 and WLIT 235.

WLIT 240. Modern Chinese Literature in Translation. 3 Units.
This course examines Modern Chinese Literature from the beginning of the 20th century to contemporary period in the contexts of Chinese historical and cultural transformations. It examines representative works of the major literary genres, including fiction, poetry, drama, and prose writing. We will be making the following inquiries: What is modern Chinese literature? What does it tell us about the cultural, social, psychological, and historical changes that occurred in modern China? Who are the main literary and cultural figures, and what did they contribute to the construction of the Chinese nation? How did Western thoughts impact on the ways in which Chinese reflected on their own cultural identities and social and gender relationships? This course is taught in English. Offered as CHIN 240, ASIA 240 and WLIT 240. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 241. Latin Prose Authors. 3 Units.
Reading and discussion of such prose authors as Cicero, Caesar, Livy or Pliny. Offered as LATN 201, LATN 401, WLIT 241 and WLIT 441. Prereq: LATN 102 or equivalent.

WLIT 245. Classical Japanese Literature in Translation. 3 Units.
Readings, in English translation, of classical Japanese poetry, essays, narratives, and drama to illustrate essential aspects of Japanese culture and sensibility before the Meiji Restoration (1868). Lectures explore the sociohistorical contexts and the character of major literary genres; discussions focus on interpreting the central images of human value within each period. Japanese sensibilities compared to and contrasted with those of Western and other cultures. Offered as JAPN 245 and WLIT 245. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 250. Classical Chinese Literature in Translation. 3 Units.
This course is a survey of the classical Chinese literature from the pre-Qin Period to the fall of Qing Dynasty in 1911. Students will be introduced to a variety of forms and genres, including classical poetry, lyric, aria, elegy, rhapsody, folk song, narrative verse, parallel prose, classical-language short story, vernacular short story, novel, drama, etc. This course is taught in English. Offered as CHIN 250, ASIA 250 and WLIT 250. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 255. Modern Japanese Literature in Translation. 3 Units.
Focus on the major genres of modern Japanese literature, including poetry, short story, and novel (shosetsu). No knowledge of Japanese language or history is assumed. Lectures, readings, and discussions are in English. Films and slides complement course readings. Offered as JAPN 255 and WLIT 255. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 290. Masterpieces of Continental Fiction. 3 Units.
Major works of fiction from the 19th century and earlier. Offered as ENGL 290 and WLIT 290.

WLIT 295. The Francophone World. 3 Units.
The course offers an introduction to the Francophone World from a historical, cultural, and literary perspective. The Francophone World includes countries and regions around the globe with a substantial French-speaking population (and where French is sometimes, but not always, an official language): North America (Louisiana, Quebec, and Acadia); North Africa (Tunisia, Morocco, Algeria, and Egypt); the Middle-East (Lebanon, Syria); the Caribbean (Martinique, Guadeloupe, Haiti); Southeast Asia (Vietnam); and Europe (France, Belgium, Switzerland, and Luxembourg). FRCH 295 provides a comprehensive overview of the Francophone World, while focusing on a particular area or areas in any given semester. Offered as ETHS 295, FRCH 295, and WLIT 295.
WLIT 300. The City in Literature. 3 Units.
Focus on major cities of the world as catalysts and reflections of cultural and historical change. Interdisciplinary approach utilizing the arts, literature, social sciences. Examples include Berlin at the turn of the century; Paris in literature and film; Tokyo in history and literature. Offered as WLIT 300 and WLIT 400.

WLIT 306. Tragedy. 3 Units.
Reading and interpretation of selected plays of Aeschylus, Euripides, and Sophocles. Offered as GREK 306, GREK 406, WLIT 306, and WLIT 406.

WLIT 307. History. 3 Units.
Extensive reading in Thucydides' History of the Peloponnesian War, especially Books VI and VII, the expedition against Syracuse. Offered as GREK 307, GREK 407, WLIT 307 and WLIT 407. Prereq: GREK 202 or equivalent.

WLIT 308. The Paris Experience. 3 Units.
Three-week immersion learning experience living and studying in Paris. The focus of the course is the literature and culture of the African, Arab, and Asian communities of Paris. Students spend a minimum of fifteen hours per week visiting cultural centers and museums and interviewing authors and students about the immigrant experience. Assigned readings complement course activities. Students enrolled in FRCH 308/408 do coursework in French. WLIT 308/408 students have the option of completing coursework in English. Graduate students have additional course requirements. Offered as FRCH 308, WLIT 308, FRCH 408, and WLIT 408. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 311. Homer. 3 Units.
Reading and translation of extensive selections from the Odyssey. Introduction to epic meter, to Homeric Greek, and to the poet’s style. Consideration of evidences of oral composition and discussion of the heroic tradition. Offered as GREK 311, GREK 411, WLIT 311 and WLIT 411.

WLIT 314. The Poetics of Eros: Love Poetry from Sappho to Shakespeare and Beyond. 3 Units.
This course will explore the theme of love in all its multiplicity of meanings and changes over time from its first appearances in Near Eastern poetry (Song of Songs) and Greek lyric (the titular Sappho) through its various elaborations, Roman, Medieval, Renaissance, and Romantic. It will also address theoretical inquiries into the nature and purpose of erotic desire and its evaluation as an aesthetic phenomenon, including Freudian theory and modern contributions such as Roland Barthes and Georges Bataille. No knowledge of the original languages required. Offered as CLSC 314 and WLIT 314. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 316. Greek Tragedy. 3 Units.
This course provides students the opportunity to read a significant number of ancient Greek tragedies in modern English translations. We shall read, study, and discuss selected works by Aeschylus, Sophocles, and Euripides, and attempt to understand the plays as literature composed for performance. We shall study literary elements within the plays and theatrical possibilities inherent in the texts. As we read the plays, we shall pay close attention to the historical context and look for what each play can tell us about myth, religion, and society in ancient Athens. Finally, we shall give occasional attention to the way these tragic dramas and the theater in which they were performed have continued to inspire literature and theater for thousands of years. Lectures will provide historical background on the playwrights, the plays, the mythic and historical background, and possible interpretation of the texts as literature and as performance pieces. Students will discuss in class the plays that they read. The course has three examinations and a final project that includes a short essay and a group presentation. Offered as CLSC 316, CLSC 416, WLIT 316, and WLIT 416. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 318. Comedy. 3 Units.
Origin, ambiance, and development of Greek Old Comedy and persisting characteristics of the genre. Translation of selected plays from Greek into English. Offered as GREK 308, GREK 408, WLIT 318, and WLIT 418.

WLIT 320. Chinese Popular Culture. 3 Units.
In this course we are going to study Chinese (including Mainland China, Hong Kong, Taiwan, and Chinese Diaspora) popular culture since the 1980s. By examining different forms of popular culture, including popular literature, film, music, TV programs, posters, the Internet, etc., we will be looking into their political, ideological, sociological, cultural, and psychological mechanisms. The film viewing will take place outside the class. Offered as: CHIN 320, ASIA 320 and WLIT 320. Counts for CAS Global & Cultural Diversity Requirement.
WLIT 322. Roman Drama and Theater. 3 Units.  
This course is designed as a continuation of and companion to CLSC/WLIT 316/416 Greek Tragedy in English Translation, although it may be taken without having taken, or before having taken, that course. Students in Roman Drama and Theater will read a significant number of ancient Roman plays in modern English translation and study non-literary theatrical entertainment of the Roman Republic and Empire, including mime and pantomime, gladiatorial shows, political speeches, courtroom drama, and various other spectacles. The dramatic texts that we shall study include the fragments of early Latin drama, selected comedies by Plautus and Terence, and the tragedies of Seneca, and the forensic speeches of statesman such as Cicero. We shall also consider Greek and Roman literature that comments on Roman theatrical practices. These works will be read for their literary merits and theatrical possibilities, while at the same time examining them for what they can tell us about Roma culture and society. Similarly, when studying the non-literary theatrical works we shall examine historical and theatrical context including archaeological evidence from theaters and amphitheaters and material remains (masks, depictions of actors and gladiators on vases, terra cotta lamps, mosaics, etc.). Finally, while the majority of the course focuses on drama originally written in Latin and theatrical entertainments performed in ancient Rome, the course will conclude with a survey of selected post-classical works indebted to the tradition of Roman drama and theater. Authors to be studied include Hrotsvitha, Marlowe, Shakespeare, Racine, Mollère, and the legacy of Roman drama and theater in contemporary stage and cinema such as Sondelm’s A Funny Thing Happened on the Way to the Forum. Thus a secondary concern will be to consider how and in what ways the legacy of Roman drama and theater has continued to shape the dramatic arts since antiquity. Offered as CLSC 322, CLSC 422, WLIT 322, and WLIT 422. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 323. Angels and Daimons: The Origins of Inspiration. 3 Units.  
The age old myth of the pact with the devil is central to some of the masterpieces of Western literature. Goethe’s poem is focused on the battle between good and evil, angelic and demonic as archetypes of humanity. The confrontation between the two forces illustrates the perennial dichotomy of creation vs. destruction (apocalypse). They represent the origin of life and its continuation even when the angelic has been defeated. The course will contain philosophical and literary readings that treat the opposition, and sometimes simultaneity, of angelic and daemonic. Plato and the Neo-Platonic tradition will be explored in the context of the mysterious forces of the invisible world. Offered as CLSC 323, CLSC 423, WLIT 323 and WLIT 423. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 324. The Sublime and Grotesque in Literature. 3 Units.  
Early on in Western culture the question of sublime and grotesque was addressed by philosophers and writers. Aristotle and especially Longinus initiated the debate over what exactly made a work of art “sublime” or “Grotesque.” This debate eventually in the 18th century gave birth to the discipline of aesthetics, which is one of the main foci of this course. To that end, in this course we will examine a few literary works in light of the most representative theories around the concept of sublime and grotesque: Aristotle, Longinus, Kant, Burke, Baumgartner, Nietzsche and Kierkegaard. Their theories will be applied to some of the most celebrated literary masterpieces written by Homer, Ovid, Dante, Cervantes and others. Offered as CLSC 324, CLSC 424, WLIT 324 and WLIT 424. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 325. Hispanic Intellectuals and Society: A Critical Approach. 3 Units.  
This course offers an overview of the most important critical approaches to Spanish American culture and literature, with a socio-historical emphasis. Some of the authors we will discuss are Angel Rama, Jose Antonio Cornejo Polar and Nestor Garcia Canclini. We will analyze how the Latin American intellectuals had thought about specific issues such as identity, race, ideology, colonial and post-colonial relations with the metropolis and the process of formation of the nations in the continent. The class, the discussions, exams, oral presentations and papers will be in Spanish. Some of the readings must be in English, but most of them will be in Spanish. Offered as SPAN 325, SPAN 425, ETHS 325, WLIT 325 and WLIT 425. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 329. Modern and Contemporary Drama. 3 Units.  
This course explores the development of western drama and theatre from 1860 through present-day productions. The course emphasizes the relationship between different theatrical representations and their historical and social context. Shakespeare’s well-known dictum that “theatre holds a mirror up to nature” is expanded when one examines who is holding that mirror, and how their actions participate in the constantly shifting construction of culture. Given this premise, the course investigates the development of specific European cultures (England, France, Germany, and Italy) as well as other regions (the United States, South America, and Russia) through the - life and literary - representations they make of themselves. Offered as THTR 329, WLIT 329 and THTR 429. Prereq: At least Sophomore standing

WLIT 331. Dante and the Classical Tradition: Middle Ages into Modernity. 3 Units.  
"Dante and the Classical Tradition" will introduce through the complex work of Dante the concept of classical tradition as an all-encompassing cultural term. Dante represents the grandiose example of the artist who seeks the complete synthesis between humanities and sciences and their incessant collaborative effort to broaden as much as possible the depths of human knowledge. Philosophy, Geography, Physics, Linguistics, Astronomy and Literature are steady landmarks in Dante’s work through which he aims to speak about the necessity of ever maintaining continuity between all domains of human knowledge. Dante’s work proposes high levels of excellence and while the course’s focus will be on his literary output the scientific interests and treatises he demonstrates will not be omitted during class discussion and bibliography included in the syllabus. Last but not least the focus will be on how we understand today the concept of classical tradition as a result of Dante’s writings. Offered as CLSC 331, CLSC 431, WLIT 331 and WLIT 431. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 333. Contemporary Caribbean Literature. 3 Units.  
In addition to developing a general familiarity with the literature and history of this region, students will acquire an awareness of the interrelation of national identity, memory, and language in the texts produced by contemporary Caribbean authors, and of the cultural hybridity characteristic of this production. The themes treated by these authors include colonialism and postcolonialism, cultural and religious syncretism, and sexual politics. Offered as SPAN 333, SPAN 433, ETHS 333, WLIT 333 and WLIT 433. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 334. Literature of the Republic. 3 Units.  
A reading course in prose and poetry of the Roman Republic. Extensive selections from Cicero and Catullus, and one comedy of Terence. Offered as LATN 305, LATN 405, WLIT 334, and WLIT 434.
WLIT 335. Women in Developing Countries. 3 Units.
This course will feature case studies, theory, and literature of current issues concerning women in developing countries primarily of the French-speaking world. Discussion and research topics include matriarchal traditions and FGM in Africa, the Tunisian feminist movement, women, Islam, and tradition in the Middle East, women-centered power structures in India (Kerala, Pondichery), and poverty and women in Vietnam, Laos, and Cambodia. Guest speakers and special projects are important elements of the course. Seminar-style format, taught in English, with significant disciplinary writing in English for WGST, ETHS, and some WLIT students, and writing in French for FRCH and WLIT students. Writing assignments include two shorter essays and a substantial research paper. Offered as ETHS 335, FRCH 335, WLIT 335, WGST 335, FRCH 435 and WLIT 435. Counts for SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 336. Elegiac Poetry. 3 Units.
In this course we shall translate and interpret selected elegies by Catullus, Tibulius, Propertius, and Ovid. We will also devote considerable class time to the reading and in-depth analysis of the major secondary literature, starting with the introductory pieces in the newest companions published by Brill and Cambridge, and moving on to fundamental articles and perhaps even a full scholarly monograph. Offered as LATN 356, LATN 456, WLIT 336, and WLIT 436.

WLIT 338. The Cameroon Experience. 3 Units.
Three-week immersion learning experience living and studying in Cameroon. The focus of the course is the culture, literature, and language of Francophone Cameroon, with some emphasis on Anglophone Cameroon. Students spend a minimum of fifteen hours per week visiting cultural sites and attending arranged courses at the University of Buea. Students will prepare a research paper. Coursework is in French. To do coursework in English, students should enroll in WLIT 338/438 or ETHS 338/438. Offered as ETHS 338, FRCH 338, WLIT 338, ETHS 438, FRCH 438, and WLIT 438. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 339. Latin American Poetic Revolt. 3 Units.
Introduction to most important poets in contemporary Latin America, a region home to a significant number of eminent poets, including Nobel Laureates from Chile, Gabriela Mistral and Pablo Neruda. The course focuses on detailed textual analysis of pivotal works, combined with historical-literary perspective, so students gain insight into the diverse styles and tendencies that reflect the tumultuous history of poetry's development in a relentless search for a Latin American cultural identity. Offered as SPAN 339, SPAN 439, WLIT 339 and WLIT 439. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 340. Seminar in Enlightenment Art and Literature: Piranesi and Vico. 3 Units.
This course explores aspects of the European eighteenth century as a transformative epoch in the history of western culture. Though the Enlightenment is usually associated especially with France, in this course we will focus on Italy, as the irresistible goal of travelers taking part in the "Grand Tour" and as a landscape of powerful ancient and modern architecture and artworks universally recognized as exemplary. In particular we will study one of the strangest and most fascinating visual artists of the period, the self-proclaimed architect Giovanni Battista Piranesi (1727-1778) famous no less now than in his own time for his fantastic prison engravings as well as his views of Rome, involving a radical rethinking of the city as a particular kind of inhabited as well as imagined space. Piranesi's polemical response to the advocates of the Greek revival, then coming into fashion, will lead into discussion of the key philosophical debates and aesthetic shifts of the time, notably the emergence of the notion of the sublime as a category eventually subversive of western ideals of rationality and still present -- and potent -- in our own culture. Finally we will place Piranesi within a current of discussion of the origins and nature of language and of human society in general, not least as manifested in architecture and other symbolic practices. The leading figure here is the Neapolitan G.B. Vico, whose New Science of 1725 remains one of the most stimulating texts in the western intellectual tradition. Offered as CLSC 340, COGS 340, WLIT 340, CLSC 440, and WLIT 440.

WLIT 342. Latin American Feminist Voices. 3 Units.
Examination of the awakening of feminine and feminist consciousness in the literary production of Latin American women writers, particularly from the 1920s to the present. Close attention paid to the dominant themes of love and dependency; imagination as evasion; alienation and rebellion; sexuality and power; the search for identity and the self-preservation of subjectivity. Readings include prose, poetry, and dramatic texts of female Latin American writers contributing to the emerging of feminist ideologies and the mapping of feminist identities. Offered as SPAN 342, SPAN 442, ETHS 342, WGST 342, WLIT 342, and WLIT 442.

WLIT 343. The New Drama in Latin American. 3 Units.
Representative works of contemporary Latin American drama. Critical examination of selected dramatic works of twentieth-century Latin America provides students insight into the nature of drama and into the structural and stylistic strategies utilized by Latin American dramatists to create the "new theater," one which is closely related to Latin American political history. Offered as SPAN 343, SPAN 434, ETHS 343, WLIT 343 and WLIT 434. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 345. Japanese Women Writers. 3 Units.
Contributions of women writers to the literature of pre-modern and modern Japan; investigations of how their works exemplify and diverge from "mainstream" literary practices. Emphasis on the social and cultural contexts of the texts. Offered as JAPN 345 and WLIT 345. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 347. Livy. 3 Units.
Readings in Books I and XXI, with other selections from this major Augustan historian. Offered as LATN 307, LATN 407, WLIT 347, and WLIT 447.

WLIT 348. Horace: Odes and Epodes. 3 Units.
Readings and discussion of extensive selections from the poetry of Horace; consideration of Horace as exemplifying the spirit of the Augustan Age. Offered as LATN 308, LATN 408, WLIT 348, and WLIT 448.
WLIT 351. Latin Didactic Literature. 3 Units.
Readings from didactic poetry such as Lucretius and Vergil’s Georgics. Parodies like Ovid’s Ars Amatoria or prose treatises may also be introduced. Offered as LATN 351, LATN 451, WLIT 351, and WLIT 451.
Prereq: 200-level LATN or equivalent.

WLIT 352. History. 3 Units.
Works of the Roman historian Cornelius Tacitus; his Annals I-VI dealing with his portrait of Emperor Tiberius and the Empire after the death of Augustus. Offered as LATN 352, LATN 452, WLIT 352, and WLIT 452.

WLIT 354. Drama. 3 Units.
Reading of at least one play each by Plautus and Terence. Attention to the history of Latin and Greek New Comedy, and the contrasting styles of the two authors. Offered as LATN 354, LATN 454, WLIT 354, and WLIT 454.

WLIT 355. Modern Japanese Novels and the West. 3 Units.
This course will compare modern Japanese and Western novelists, drama, and novels. Comparisons will focus on the themes of family, gender and alienation, which subsume a number of interrelated sub-themes such as marriage, home, human sexuality, amae (dependence), innocence, experience, death, God/gods, and nature (the ecosystem). Offered as JAPN 355 and WLIT 355. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 356. Afro-Hispanic Literature. 3 Units.
This course will survey the literary and cultural production of writers and artists of African descent in Latin America and the Caribbean, paying attention to both their creative and theoretical texts. Discussion of questions of race and ethnicity will allow students to explore the ways in which these texts reformulate the idea of national identity and cultural belonging in the context of the nation-state, whose traditional centrality is being weakened through the effects of migration and exile. Readings include works by writers from Cuba, Puerto Rico, Dominican Republic, Costa Rica, Colombia, Panama, Ecuador, and Peru. Offered as SPAN 356, SPAN 456, ETHS 356, WLIT 356 and WLIT 456. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 358. Latin American Cinema. 3 Units.
This course is designed to introduce students to the basic tools of film analysis as well as to the major trends and movements in Latin American cinema from the 1960s to the present. Through the analysis of representative films from Latin America, the course will examine the development of a variety of cinematic styles, paying particular attention to the historical contexts in which the films were produced and to the political, cultural, and aesthetic debates that surrounded their production. Offered as SPAN 358, SPAN 458, ETHS 358, WLIT 358 and WLIT 458. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 360. Development of Theater: Beginnings to English Renaissance. 3 Units.
This course explores the foundations of theater in Western civilization, beginning with Greece and then charting and analyzing the developments in playwriting, design, acting and theater architecture. Students read a wide variety of plays in order to obtain a comprehensive understanding of the history of the art form, but also learn how theater has played an integral societal function as a medium of political, economic, and cultural commentary. Development of Theater I explores developments from Aeschylus to the English Renaissance. Offered for undergraduates as THTR 325 and WLIT 360. Students who have taken THTR 228/WLIT 228 are not allowed to enroll in this course. Offered as THTR 325, WLIT 360, and THTR 425. Prereq: At least Sophomore standing.

WLIT 361. Development of Theater: Renaissance to Romanticism. 3 Units.
This course explores the many developments in playwriting, design, acting, and theater architecture across the world. Students read a wide variety of plays in order to obtain a comprehensive understanding of the history of the art form, but also learn how theater has played an integral societal function as a medium of political, economic, and cultural commentary. Development of Theater II not only explores the development of theatrical conventions in Spain, England, Italy, France and other European countries that lead to the creation of modern drama, but the course also offers an in-depth look at the history and conventions of theater in India, Korea, China, and Japan. Offered as THTR 326, WLIT 361, and THTR 426. Counts for SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement. Prereq: At least Sophomore standing.

WLIT 363H. African-American Literature. 3 Units.
A historical approach to African-American literature. Such writers as Wheatley, Equiano, Douglass, Jacobs, DuBois, Hurston, Hughes, Wright, Baldwin, Ellison, Morrison. Topics covered may include slave narratives, African-American autobiography, the Harlem Renaissance, the Black Aesthetic, literature of protest and assimilation. Maximum 6 credits. Offered as ENGL 363H, ETHS 363H, WLIT 363H, ENGL 463H, and WLIT 463H. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

WLIT 365. German Literature in Translation. 3 Units.
Goethe defined “World Literature” (Weltliteratur) as “Intellectual Trade Relations” (geistiger Handelsverkehr). This course gives students the opportunity to study German literary works in translation and thus to trade intellectual relations with a literary culture previously unknown to them. Counts toward the German major only as a related course. No knowledge of German required. Offered as GRMN 365 and WLIT 365.

WLIT 365E. The Immigrant Experience. 3 Units.
Study of fictional and/or autobiographical narrative by authors whose families have experienced immigration to the U.S. Among the ethnic groups represented are Asian-American, Jewish-American, Hispanic-American. May include several ethnic groups or focus on a single one. Attention is paid to historical and social aspects of immigration and ethnicity. Maximum 6 credits. Offered as ENGL 365E, WLIT 365E, ENGL 465E, and WLIT 465E. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

WLIT 365N. Topics in African-American Literature. 3 Units.
Selected topics and writers from nineteenth, twentieth, and twenty-first century African-American literature. May focus on a genre, a single author or a group of authors, a theme or themes. Maximum 6 credits. Offered as ENGL 365N, ETHS 365N, WLIT 365N, ENGL 465N, and WLIT 465N. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

WLIT 365Q. Post-Colonial Literature. 3 Units.
Readings in national and regional literatures from former European colonies such as Australia and African countries. Maximum 6 credits. Offered as ENGL 365Q, ETHS 365Q, WLIT 365Q, ENGL 465Q, and WLIT 465Q. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.
WLIT 366G. Minority Literatures. 3 Units.
A course dealing with literature produced by ethnic and racial minority groups within the U.S. Individual offerings may include works from several groups studied comparatively, or focus on a single group, such as Native Americans, Chicanos/Chicanas, Asian-Americans, Caribbean-Americans. African-American works may also be included. May cover the entire history of the U.S. or shorter periods. Maximum 6 credits. Offered as ENGL 366G, WLIT 366G, ENGL 466G, and WLIT 466G. Counts for CAS Global & Cultural Diversity Requirement. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

WLIT 368. Topics in Film. 3 Units.
Individual topics in film, such as a particular national cinema, horror films, films of Alfred Hitchcock, images of women in film, film comedy, introduction to film genres, Asian-cinema and drama, dance on screen, science fiction films, storytelling and cinema, and literature and film. A student who has previously taken ENGL 368C may receive credit for ENGL 368 only if the themes/topics are different. Offered as ENGL 368, ENGL 468, WLIT 368, and WLIT 468.

WLIT 370. Greek Prose Composition. 3 Units.
This course introduces students to the principles and practice of composing continuous passages of Greek prose. It is designed to review and to strengthen students’ command of Attic forms while becoming more aware of the ways Greek prose was employed to express thought. Via practice at writing Greek prose, the ultimate goal is for the students to become more proficient and sensitive readers of ancient Greek. Offered as GREK 370, GREK 470, WLIT 370 and WLIT 470.

WLIT 375. Russian Literature in Translation. 3 Units.
Topics vary according to student and faculty interest. May include Russian classical and modern literature, cinema, women writers, individual authors. May count towards Russian minor. No knowledge of Russian required. Offered as RUSN 375 and WLIT 375. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 385. Hispanic Literature in Translation. 3 Units.
Critical analysis and appreciation of representative literary masterpieces from Spain and Latin America, and by Hispanics living in the U.S. Texts cover a variety of genres and a range of literary periods, from works by Cervantes to those of Gabriel Garcia Marquez. The course will examine the relationship between literature and other forms of artistic production, as well as the development of the Hispanic literary text within the context of historical events and cultural production of the period. Counts toward Spanish major only as related course. No knowledge of Spanish required. Offered as ETHS 385, ETHS 485, SPAN 385, SPAN 485, WLIT 385, and WLIT 485.

WLIT 387. Literary and Critical Theory. 3 Units.
A survey of major schools and texts of literary and critical theory. May be historically or thematically organized. Maximum 6 credits. Offered as ENGL 387, WLIT 387, ENGL 487, and WLIT 487. Prereq: ENGL 150 or passing letter grade in a 100 level first year seminar in FSCC, FSNA, FSSO, FSSY, FSTS, or FSCS.

WLIT 390. Topics in World Literature. 3 Units.
In-depth examination of specific critical and literary theories and of their relevance for literature and culture studies. Authors, works and instructor may vary. Offered as WLIT 390 and WLIT 490.

WLIT 391. Introduction to Text Semiotics. 3 Units.
Introduction to Text Semiotics addresses both students of Literature and students in Cognitive Science. Most of the authors included in the reading list extend their linguistic approach towards fields that intersect literature, psychology, philosophy, aesthetics, and anthropology. The scholarly traditions of text analysis and structural theory of meaning, including authors from classical formalism, structuralism, structural semiotics, and new criticism will be connected to cognitive theories of meaning construction in text, discourse, and cultural expressions in general. The focus of this course, taught as a seminar, is on empirical studies, specific text analyses, discourse analyses, speech act analyses, and other studies of speech, writing, and uses of language in cultural contexts. This course thus introduces to a study of literature and cultural expressions based on cognitive science and modern semiotics—the new view that has be coined Cognitive Semiotics. Offered as COGS 391 and WLIT 391.

WLIT 395. Advanced Topics in Akkadian Literature. 3 Units.
Directed readings in selected Akkadian texts in the cuneiform script either of the Old Babylonian or the Neo-Assyrian periods to serve the individual interests and needs of students (texts may be drawn from a variety of text genres: mythological, historical, scientific, medical, correspondence, religious, etc.). Offered as AKKD 395, AKKD 495, WLIT 395 and WLIT 495. Counts for CAS Global & Cultural Diversity Requirement. Prereq: AKKD 101 and AKKD 102.

WLIT 397. Honors Thesis I. 3 Units.
Intensive study of a literary, linguistic, or cultural topic with a faculty member, leading to the writing of a research paper. Prereq: Senior status.

WLIT 398. Honors Thesis II. 3 Units.
Continuation of WLIT 397. Prereq: WLIT 397 and senior status.

WLIT 399. Independent Study. 1 - 3 Units.
For majors and advanced students under special circumstances.

WLIT 400. The City in Literature. 3 Units.
Focus on major cities of the world as catalysts and reflections of cultural and historical change. Interdisciplinary approach utilizing the arts, literature, social sciences. Examples include Berlin at the turn of the century; Paris in literature and film; Tokyo in history and literature. Offered as WLIT 300 and WLIT 400. Prereq: Graduate standing.

WLIT 401. Greek Prose Authors. 3 Units.
Readings from authors such as Plato, Lysias, Xenophon, and Herodotus. Offered as GREK 201, GREK 401, WLIT 201 and WLIT 401.

WLIT 402. Introduction to Greek Poetry. 3 Units.
Primarily readings from Homer, Hesiod, and Theocritus. Selections from Greek lyric may be introduced at the instructor’s discretion. Offered as GREK 202, GREK 402, WLIT 202, and WLIT 402.

WLIT 405. Readings from the Epic of Gilgamesh. 3 Units.
In this course, we will read the entire Standard Babylonian recension of the Epic of Gilgamesh, considered the first great work of literature, from the original Akkadian text. While the primary goal of the course will be to become proficient readers of Akkadian, we will take some excursus on topics such as Babylonian religion, whether Gilgamesh was a historical figure or not, how the text was put together, and its possible influence on later heroic traditions such as the Greco-Roman. Offered as AKKD 205, AKKD 405, WLIT 205 and WLIT 405. Counts for CAS Global & Cultural Diversity Requirement. Prereq: AKKD 101 and AKKD 102.

WLIT 406. Tragedy. 3 Units.
Reading and interpretation of selected plays of Aeschylus, Euripides, and Sophocles. Offered as GREK 306, GREK 406, WLIT 306, and WLIT 406.
WLIT 407. History. 3 Units.
Extensive reading in Thucydides’ History of the Peloponnesian War, especially Books VI and VII, the expedition against Syracuse. Offered as GREK 307, GREK 407, WLIT 307 and WLIT 407.

WLIT 408. The Paris Experience. 3 Units.
Three-week immersion learning experience living and studying in Paris. The focus of the course is the literature and culture of the African, Arab, and Asian communities of Paris. Students spend a minimum of fifteen hours per week visiting cultural centers and museums and interviewing authors and students about the immigrant experience. Assigned readings complement course activities. Students enrolled in FRCH 308/408 do coursework in French. WLIT 308/408 students have the option of completing coursework in English. Graduate students have additional course requirements. Offered as FRCH 308, WLIT 308, FRCH 408, and WLIT 408. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

WLIT 411. Homer. 3 Units.
Reading and translation of extensive selections from the Odyssey. Introduction to epic meter, to Homeric Greek, and to the poet’s style. Consideration of evidences of oral composition and discussion of the heroic tradition. Offered as GREK 311, GREK 411, WLIT 311 and WLIT 411.

WLIT 416. Greek Tragedy. 3 Units.
This course provides students the opportunity to read a significant number of ancient Greek tragedies in modern English translations. We shall read, study, and discuss selected works by Aeschylus, Sophocles, and Euripides, and attempt to understand the plays as literature composed for performance. We shall study literary elements within the plays and theatrical possibilities inherent in the texts. As we read the plays, we shall pay close attention to the historical context and look for what each play can tell us about myth, religion, and society in ancient Athens. Finally, we shall give occasional attention to the way these tragic dramas and the theater in which they were performed have continued to inspire literature and theater for thousands of years. Lectures will provide historical background on the playwrights, the plays, the mythic and historical background, and possible interpretation of the texts as literature and as performance pieces. Students will discuss in class the plays that they read. The course has three examinations and a final project that includes a short essay and a group presentation. Offered as CLSC 316, CLSC 416, WLIT 316, and WLIT 416. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 418. Comedy. 3 Units.
Origin, ambiance, and development of Greek Old Comedy and persisting characteristics of the genre. Translation of selected plays from Greek into English. Offered as GREK 308, GREK 408, WLIT 318, and WLIT 418.

WLIT 422. Roman Drama and Theater. 3 Units.
This course is designed as a continuation of and companion to CLSC/WLIT 316/416 Greek Tragedy in English Translation, although it may be taken without having taken, or before having taken, that course. Students in Roman Drama and Theater will read a significant number of ancient Roman plays in modern English translation and study non-literary theatrical entertainment of the Roman Republic and Empire, including mime and pantomime, gladiatorial shows, political speeches, courtroom drama, and various other spectacles. The dramatic texts that we shall study include the fragments of early Latin drama, selected comedies by Plautus and Terence, and the tragedies of Seneca, and the forensic speeches of statesman such as Cicero. We shall also consider Greek and Roman literature that comments on Roman theatrical practices. These works will be read for their literary merits and theatrical possibilities, while at the same time examining them for what they can tell us about Roma culture and society. Similarly, when studying the non-literary theatrical works we shall examine historical and theatrical context including archaeological evidence from theaters and amphitheaters and material remains (masks, depictions of actors and gladiators on vases, terra cotta lamps, mosaics, etc.). Finally, while the majority of the course focuses on drama originally written in Latin and theatrical entertainments performed in ancient Rome, the course will conclude with a survey of selected post-classical works indebted to the tradition of Roman drama and theater. Authors to be studied include Hrotsvitha, Marlowe, Shakespeare, Racine, Molière, and the legacy of Roman drama and theater in contemporary stage and cinema such as Sondheim’s A Funny Thing Happened on the Way to the Forum. Thus a secondary concern will be to consider how and in what ways the legacy of Roman drama and theater has continued to shape the dramatic arts since antiquity. Offered as CLSC 322, CLSC 422, WLIT 322, and WLIT 422. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 423. Angels and Daimons: The Origins of Inspiration. 3 Units.
The age old myth of the pact with the devil is central to some of the masterpieces of Western literature. Goethe’s poem is focused on the battle between good and evil, angelic and demonic as archetypes of humanity. The confrontation between the two forces illustrates the perennial dichotomy of creation vs. destruction (apocalypse). They represent the origin of life and its continuation even when the angelic has been defeated. The course will contain philosophical and literary readings that treat the opposition, and sometimes simultaneity, of angelic and daimonic. Plato and the Neo-Platonic tradition will be explored in the course as well as various readings from Middle Ages up to 18th century that address the issue of inspiration through contamination with the mysterious forces of the invisible world. Offered as CLSC 323, CLSC 423, WLIT 323 and WLIT 423. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 424. The Sublime and Grotesque in Literature. 3 Units.
Early on in Western culture the question of sublime and grotesque was addressed by philosophers and writers. Aristotle and especially Longinus initiated the debate over what exactly made a work of art ”sublime” or ”Grotesque.” This debate eventually in the 18th century gave birth to the discipline of aesthetics, which is one of the main foci of this course. To that end, in this course we will examine a few literary works in light of the most representative theories around the concept of sublime and grotesque: Aristotle, Longinus, Kant, Burke, Baumgartner, Nietzsche and Kierkegaard. Their theories will be applied to some of the most celebrated literary masterpieces written by Homer, Ovid, Dante, Cervantes and others. Offered as CLSC 324, CLSC 424, WLIT 324 and WLIT 424. Counts for CAS Global & Cultural Diversity Requirement.
WLIT 425. Hispanic Intellectuals and Society: A Critical Approach. 3 Units.
This course offers an overview of the most important critical approaches to Spanish American culture and literature, with a socio-historical emphasis. Some of the authors we will discuss are Angel Rama, Jose Antonio Cornejo Polar and Nestor Garcia Canclini. We will analyze how the Latin American intellectuals had thought about specific issues such as identity, race, ideology, colonial and post-colonial relations with the metropolis and the process of formation of the nations in the continent. The class, the discussions, exams, oral presentations and papers will be in Spanish. Some of the readings must be in English, but most of them will be in Spanish. Offered as SPAN 325, SPAN 425, ETHS 325, WLIT 325 and WLIT 425. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 431. Dante and the Classical Tradition: Middle Ages into Modernity. 3 Units.
"Dante and the Classical Tradition" will introduce through the complex work of Dante the concept of classical tradition as an all-encompassing cultural term. Dante represents the grandiose example of the artist who seeks the complete synthesis between humanities and sciences and their incessant collaborative effort to broaden as much as possible the depths of human knowledge. Philosophy, Geography, Physics, Linguistics, Astronomy and Literature are steady landmarks in Dante's work through which he aims to speak about the necessity of ever maintaining continuity between all domains of human knowledge. Dante's work proposes high levels of excellence and while the course's focus will be on his literary output the scientific interests and treatises he demonstrates will not be omitted during class discussion and bibliography included in the syllabus. Last but not least the focus will be on how we understand today the concept of classical tradition as a result of Dante's writings. Offered as CLSC 331, CLSC 431, WLIT 331 and WLIT 431. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 432. Vergil. 3 Units.
Primarily readings from The Aeneid; selections from Vergil's other work may be introduced at instructor's discretion. Recommended preparation: LATN 201 or equivalent. Offered as LATN 202, LATN 402, WLIT 232 and WLIT 432.

WLIT 433. Contemporary Caribbean Literature. 3 Units.
In addition to developing a general familiarity with the literature and history of this region, students will acquire an awareness of the interrelational of national identity, memory, and language in the texts produced by contemporary Caribbean authors, and of the cultural hybridity characteristic of this production. The themes treated by these authors include colonialism and postcolonialism, cultural and religious syncretism, and sexual politics. Offered as SPAN 333, SPAN 433, ETHS 333, WLIT 333 and WLIT 433. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 434. Literature of the Republic. 3 Units.
A reading course in prose and poetry of the Roman Republic. Extensive selections from Cicero and Catullus, and one comedy of Terence. Offered as LATN 305, LATN 405, WLIT 334, and WLIT 434.

WLIT 435. Women in Developing Countries. 3 Units.
This course will feature case studies, theory, and literature of current issues concerning women in developing countries primarily of the French-speaking world. Discussion and research topics include matriarchal traditions and FGM in Africa, the Tunisian feminist movement, women, Islam, and tradition in the Middle East, women-centered power structures in India (Kerala, Pondicherry), and poverty and women in Vietnam, Laos, and Cambodia. Guest speakers and special projects are important elements of the course. Seminar-style format, taught in English, with significant disciplinary writing in English for WGST, ETHS, and some WLIT students, and writing in French for FRCH and WLIT students. Writing assignments include two shorter essays and a substantial research paper. Offered as ETHS 335, FRCH 335, WLIT 335, WGST 335, FRCH 435 and WLIT 435. Counts as SAGES Departmental Seminar. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 436. Elegiac Poetry. 3 Units.
In this course we shall translate and interpret selected elegies by Catullus, Tibullus, Propertius, and Ovid. We will also devote considerable class time to the reading and in-depth analysis of the major secondary literature, starting with the introductory pieces in the newest companions published by Brill and Cambridge, and moving on to fundamental articles and perhaps even a full scholarly monograph. Offered as LATN 356, LATN 456, WLIT 336, and WLIT 436.

WLIT 438. The Cameroon Experience. 3 Units.
Three-week immersion learning experience living and studying in Cameroon. The focus of the course is the culture, literature, and language of Francophone Cameroon, with some emphasis on Anglophone Cameroon. Students spend a minimum of fifteen hours per week visiting cultural sites and attending arranged courses at the University of Buea. Students will prepare a research paper. Coursework is in French. To do coursework in English, students should enroll in WLIT 338/438 or ETHS 338/438. Offered as ETHS 338, FRCH 338, WLIT 338, ETHS 438, FRCH 438, and WLIT 438. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 439. Latin American Poetic Revolt. 3 Units.
Introduction to most important poets in contemporary Latin America, a region home to a significant number of eminent poets, including Nobel Laureates from Chile, Gabriela Mistral and Pablo Neruda. The course focuses on detailed textual analysis of pivotal works, combined with historical-literary perspective, so students gain insight into the diverse styles and tendencies that reflect the tumultuous history of poetry's development in a relentless search for a Latin American cultural identity. Offered as SPAN 339, SPAN 439, WLIT 339 and WLIT 439. Counts for CAS Global & Cultural Diversity Requirement.
WLIT 440. Seminar in Enlightenment Art and Literature: Piranesi and Vico. 3 Units.
This course explores aspects of the European eighteenth century as a transformative epoch in the history of western culture. Though the Enlightenment is usually associated especially with France, in this course we will focus on Italy, as the irresistible goal of travelers taking part in the "Grand Tour," and as a landscape of powerful ancient and modern architecture and artworks universally recognized as exemplary. In particular we will study one of the strangest and most fascinating visual artists of the period, the self-proclaimed architect Giovanni Battista Piranesi (1720-1778) famous no less now than in his own time for his fantastic prison engravings as well as his views of Rome, involving a radical rethinking of the city as a particular kind of inhabited as well as imagined space. Piranesi's polemical response to the advocates of the Greek revival, then coming into fashion, will lead into discussion of the key philosophical debates and aesthetic shifts of the time, notably the emergence of the notion of the sublime as a category eventually subversive of western ideals of rationality and still present -- and potent -- in our own culture. Finally we will place Piranesi within a current of discussion of the origins and nature of language and of human society in general, not least as manifested in architecture and other symbolic practices. The leading figure here is the Neapolitan G.B. Vico, whose New Science of 1725 remains one of the most stimulating texts in the western intellectual tradition. Offered as CLSC 340, COGS 340, WLIT 340, CLSC 440, and WLIT 440.

WLIT 441. Latin Prose Authors. 3 Units.
Reading and discussion of such prose authors as Cicero, Caesar, Livy or Pliny. Offered as LATN 201, LATN 401, WLIT 241 and WLIT 441.

WLIT 442. Latin American Feminist Voices. 3 Units.
Examination of the awakening of feminine and feminist consciousness in the literary production of Latin American women writers, particularly from the 1920s to the present. Close attention paid to the dominant themes of love and dependency; imagination as evasion; alienation and rebellion; sexuality and power; the search for identity and the self-preservation of subjectivity. Readings include prose, poetry, and dramatic texts of female Latin American writers contributing to the emerging of feminist ideologies and the mapping of feminist identities. Offered as SPAN 342, SPAN 442, ETHS 342, WGST 342, WLIT 342, and WLIT 442.

WLIT 443. The New Drama in Latin America. 3 Units.
Representative works of contemporary Latin American drama. Critical examination of selected dramatic works of twentieth-century Latin America provides students insight into the nature of drama and into the structural and stylistic strategies utilized by Latin American dramatists to create the "new theater," one which is closely related to Latin American political history. Offered as SPAN 343, SPAN 434, ETHS 343, WLIT 343 and WLIT 434. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 447. Livy. 3 Units.
Readings in Books I and XXI, with other selections from this major Augustan historian. Offered as LATN 307, LATN 407, WLIT 347, and WLIT 447.

WLIT 448. Horace: Odes and Epodes. 3 Units.
Readings and discussion of extensive selections from the poetry of Horace; consideration of Horace as exemplifying the spirit of the Augustan Age. Offered as LATN 308, LATN 408, WLIT 348, and WLIT 448.

WLIT 451. Latin Didactic Literature. 3 Units.
Readings from didactic poetry such as Lucretius and Vergil's Georgics. Parodies like Ovid's Ars Amatoria or prose treatises may also be introduced. Offered as LATN 351, LATN 451, WLIT 351, and WLIT 451.

WLIT 452. History. 3 Units.
Works of the Roman historian Cornelius Tacitus; his Annals I-VI dealing with his portrait of Emperor Tiberius and the Empire after the death of Augustus. Offered as LATN 352, LATN 452, WLIT 352, and WLIT 452.

WLIT 454. Drama. 3 Units.
Reading of at least one play each by Plautus and Terence. Attention to the history of Latin and Greek New Comedy, and the contrasting styles of the two authors. Offered as LATN 354, LATN 454, WLIT 354, and WLIT 454.

WLIT 456. Afro-Hispanic Literature. 3 Units.
This course will survey the literary and cultural production of writers and artists of African descent in Latin America and the Caribbean, paying attention to both their creative and theoretical texts. Discussion of questions of race and ethnicity will allow students to explore the ways in which these texts reformulate the idea of national identity and cultural belonging in the context of the nation-state, whose traditional centrality is being weakened through the effects of migration and exile. Readings include works by writers from Cuba, Puerto Rico, Dominican Republic, Costa Rica, Colombia, Panama, Ecuador, and Peru. Offered as SPAN 356, SPAN 456, ETHS 356, WLIT 356 and WLIT 456. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 458. Latin American Cinema. 3 Units.
This course is designed to introduce students to the basic tools of film analysis as well as to the major trends and movements in Latin American cinema from the 1960s to the present. Through the analysis of representative films from Latin America, the course will examine the development of a variety of cinematic styles, paying particular attention to the historical contexts in which the films were produced and to the political, cultural, and aesthetic debates that surrounded their production. Offered as SPAN 358, SPAN 458, ETHS 358, WLIT 358 and WLIT 458. Counts for CAS Global & Cultural Diversity Requirement.

WLIT 463H. African-American Literature. 3 Units.
A historical approach to African-American literature. Such writers as Wheatley, Equiano, Douglass, Jacobs, DuBois, Hurston, Hughes, Wright, Baldwin, Ellison, Morrison. Topics covered may include slave narratives, African-American autobiography, the Harlem Renaissance, the Black Aesthetic, literature of protest and assimilation. Maximum 6 credits. Offered as ENGL 363H, ENGL 363H, WLIT 363H, ENGL 463H, and WLIT 463H. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

WLIT 465E. The Immigrant Experience. 3 Units.
Study of fictional and/or autobiographical narrative by authors whose families have experienced immigration to the U.S. Among the ethnic groups represented are Asian-American, Jewish-American, Hispanic-American. May include several ethnic groups or focus on a single one. Attention is paid to historical and social aspects of immigration and ethnicity. Maximum 6 credits. Offered as ENGL 365E, WLIT 365E, ENGL 465E, and WLIT 465E. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

WLIT 465N. Topics in African-American Literature. 3 Units.
Selected topics and writers from nineteenth, twentieth, and twenty-first century African-American literature. May focus on a genre, a single author or a group of authors, a theme or themes. Maximum 6 credits. Offered as ENGL 365N, ETHS 365N, WLIT 365N, ENGL 465N, and WLIT 465N. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.
WLIT 465Q. Post-Colonial Literature. 3 Units.
Readings in national and regional literatures from former European colonies such as Australia and African countries. Maximum 6 credits. Offered as ENGL 365Q, ETHS 365Q, WLIT 365Q, ENGL 465Q, and WLIT 465Q. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

WLIT 466G. Minority Literatures. 3 Units.
A course dealing with literature produced by ethnic and racial minority groups within the U.S. Individual offerings may include works from several groups studied comparatively, or focus on a single group, such as Native Americans, Chicanos/Chicanas, Asian-Americans, Caribbean-Americans. African-American works may also be included. May cover the entire history of the U.S. or shorter periods. Maximum 6 credits. Offered as ENGL 366G, WLIT 366G, ENGL 466G, and WLIT 466G. Counts for CAS Global & Cultural Diversity Requirement. Prereq: Graduate standing.

WLIT 468. Topics in Film. 3 Units.
Individual topics in film, such as a particular national cinema, horror films, films of Alfred Hitchcock, images of women in film, film comedy, introduction to film genres, Asian-cinema and drama, dance on screen, science fiction films, storytelling and cinema, and literature and film. A student who has previously taken ENGL 368C may receive credit for ENGL 368 only if the themes/topics are different. Offered as ENGL 368, ENGL 468, WLIT 368, and WLIT 468. Prereq: Graduate standing.

WLIT 470. Greek Prose Composition. 3 Units.
This course introduces students to the principles and practice of composing continuous passages of Greek prose. It is designed to review and to strengthen students’ command of Attic forms while becoming more aware of the ways Greek syntax was employed to express thought. Via practice at writing Greek prose, the ultimate goal is for the students to become more proficient and sensitive readers of ancient Greek. Offered as GREK 370, GREK 470, WLIT 370 and WLIT 470.

WLIT 485. Hispanic Literature in Translation. 3 Units.
Critical analysis and appreciation of representative literary masterpieces from Spain and Latin America, and by Hispanics living in the U.S. Texts cover a variety of genres and a range of literary periods, from works by Cervantes to those of Gabriel Garcia Marquez. The course will examine the relationship between literature and other forms of artistic production, as well as the development of the Hispanic literary text within the context of historical events and cultural production of the period. Counts toward Spanish major only as related course. No knowledge of Spanish required. Offered as ETHS 385, ETHS 485, SPAN 385, SPAN 485, WLIT 385, and WLIT 485. Prereq: Graduate standing.

WLIT 487. Literary and Critical Theory. 3 Units.
A survey of major schools and texts of literary and critical theory. May be historically or thematically organized. Maximum 6 credits. Offered as ENGL 387, WLIT 387, ENGL 487, and WLIT 487. Prereq: Graduate standing.

WLIT 490. Topics in World Literature. 3 Units.
In-depth examination of specific critical and literary theories and of their relevance for literature and culture studies. Authors, works and instructor may vary. Offered as WLIT 390 and WLIT 490. Prereq: Graduate standing.

WLIT 495. Advanced Topics in Akkadian Literature. 3 Units.
Directed readings in selected Akkadian texts in the cuneiform script either of the Old Babylonian or the Neo-Assyrian periods to serve the individual interests and needs of students (texts may be drawn from a variety of text genres: mythological, historical, scientific, medical, correspondence, religious, etc.). Offered as AKKD 395, AKKD 495, WLIT 395 and WLIT 495. Counts for CAS Global & Cultural Diversity Requirement. Prereq: AKKD 101 and AKKD 102.

WLIT 590. Seminar in World Literature. 3 Units.
Topics vary depending on student and instructor interests; may include Postcolonial literature; Latin American literature and film; African Anglophone and Francophone literature. Prereq: Graduate standing.

WLIT 595. Independent Research. 1 - 3 Units.
For graduate students under special circumstances. Prereq: Graduate standing.

WLIT 601. Independent Study. 1 - 18 Units.
For graduate students under special circumstances. Prereq: Graduate standing.

WLIT 651. Thesis M.A.. 1 - 18 Units.
FRANCES PAYNE BOLTON SCHOOL OF NURSING

History
The Frances Payne Bolton School of Nursing (http://fpb.case.edu) at Case Western Reserve University is a globally recognized leader in nursing education, research, and practice. Our commitment to excellence is visible in our distinguished faculty, small class sizes, world renowned clinical partners and academic innovations. While its roots date back to 1898 with the founding of the Lakeside Hospital Training School for Nurses, the school was formally established in 1923 as one of the first two colleges of nursing within a university through a gift from its namesake, Frances Payne Bolton, the first congresswoman from Ohio.

Today, the School of Nursing offers curricula for students at all levels of study-undergraduate, graduate entry nursing and advanced preparation in nursing. Master’s level learning is available in nurse anesthesia, nurse midwifery, acute and primary care both in adult-health, women’s health and education with population focus. The nursing school also offers two doctoral level degrees—the Doctor of Nursing Practice (DNP) and the PhD in Nursing, as well as a dual doctorate program. Areas of research include symptom science, family and community care, aging across the lifespan, self-management of health and illness, and neuroscience.

Strategic Vision
Mission
The Frances Payne Bolton School of Nursing at Case Western Reserve University provides leadership in innovative research, education, and practice to promote health and reduce the burden of disease. Dedicated to interdisciplinary scholarship, we are committed to the pursuit of excellence in service to local and global communities.

Vision
Our vision is to create and nurture a learning environment that builds on our tradition of scientific inquiry and commitment to the highest standards of excellence in research, education, and practice in the world community, and to continue our rich history of innovation and global contributions.

Purpose
The purpose of the Frances Payne Bolton School of Nursing is to provide an environment that permits individuals to develop their personal and professional capabilities, including the sense of responsibility for continued learning; to learn as efficiently and effectively as possible; to find enjoyment, excitement, and challenge in the pursuit of knowledge and its application; and to develop behaviors that enable them to function in a changing, complex society. As an integral component of Case Western Reserve University, the school assumes responsibility for the preparation of individuals committed to excellence and leadership in professional nursing. The faculty of the school accepts the responsibility for teaching and scholarly inquiry as integral parts of the educational process.

Philosophy
FPB has set forth the following philosophy to accomplish the stated mission.

Nursing is an academic discipline and profession. Nursing as an academic discipline is a distinct branch of human knowledge fundamental to nursing practice, nursing education, and nursing administration, and to the continuous development of the profession. The distinct perspective of nursing includes a focus on the meta-paradigm concepts of persons, environment and nursing. The conceptual focus within FPB is on health-seeking mechanisms and behaviors of human beings. Some of those mechanisms and behaviors are innate; others are learned or developed and may be subject to the influence of nurses’ knowledgeable ministrations. The body of nursing knowledge is continuously advanced, structured, and restructured as a consequence of a range of methods including scientific inquiry, philosophic inquiry, historical inquiry, and clinical evaluation.

Scientific inquiry within nursing is designed to discover, advance, and clarify knowledge about determinants and correlates of optimal biological, psychological, and social functioning; physical, emotional and spiritual comfort; and individual and group attainment of health goals in multiple environments and under a variety of circumstances (including illness and injury) attendant to birth, living, development, decline and death. Philosophic inquiry is undertaken to clarify the values that underlie consumers’ and nurses’ responsibilities for human health promotion, the ethics of nursing practice, and the nature of the body of knowledge known as nursing. Historical inquiry is undertaken to document significant influences (by events and individuals) on the development of nursing over time as a body of knowledge and as a profession. Clinical evaluation is designed to test and verify the relative efficacy of strategies used in nursing administration, consultation, education, and practice, and the means employed to advance nursing knowledge.

Professional nurses have mastery over a body of scientific and humanistic knowledge that is fundamental to their particular kinds of practice. They selectively use this knowledge in the execution of their professional responsibilities and in the attainment of professional goals. Those involved in differentiated nursing practices employ nursing technologies (skills and approaches that represent the application of scientific knowledge), using artistry in the execution of their professional responsibilities. Professional nurses’ several, particular practices are guided by a code of professional ethics and also by knowledge about the individuals and groups whom they serve. The nurse’s professional goal is to appraise accurately and to enhance effectively the health status, health assets, and health potentials of individuals, groups, families, and communities and to promote the initiative and independence of those they serve in the attainment of reasonable health goals, mutually agreed upon by consumers and by nurses as their health care providers. Nursing practice includes assisting persons in the maintenance of health, detecting deviations from health, assisting persons in the restoration of health, and supporting persons during life. These responsibilities are accomplished through a systematic and deliberative process. Nursing practice includes independent and interdependent functions and nurses are an integral part of the health care system.

Other beliefs essential to nursing that are shared by the faculty are stated below.

Nursing Strategies
Nursing strategies can be categorized according to the function they serve in facilitating clients’ health-seeking behaviors. A tentative classification scheme according to the function strategies is set forth below. Within each category there are multiple behaviors from which the nurse can select depending on the nature of the clients’ assets and
deficits. Also, each category is open to the discovery of more activities than are presently known. Each category focuses on facilitating health-seeking behaviors.

**Compensating:** Performing selected activities or measures (including monitoring) for clients when they are unable to do these activities.

**Teaching:** Performing actions intended to induce learning.

**Counseling:** Assisting clients to examine an alternative course of action.

**Supporting:** Promoting clients' ability to cope, adapt and change.

**Stimulating:** Promoting clients' desire to perform health-seeking behaviors.

**Advocating:** Intervening on behalf of the client to overcome obstacles that are interfering with health-seeking behaviors.

**Comforting:** Providing an environment that promotes ease and well-being.

The choice of nursing strategies for enhancing client's health-seeking behaviors is based on assessment of these behaviors and the intervening variables to determine the assets and deficits and potential for engaging in behaviors that are directed toward attaining, maintaining or regaining an optimal level of health.

**FPB Accreditation and Approvals**

**Accreditation**

Case Western Reserve University is accredited at the institutional level by the Higher Learning Commission (http://www.ncahlc.org):

- North Central Association of Colleges and Schools
  The Higher Learning Commission
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  info@ncahihe.org
  http://www.ncahlc.org/

The University is chartered as an educational institution under the laws of the State of Ohio and holds a Certificate of Authorization from the Ohio Department of Higher Education (https://www.ohiohighered.org) (formerly known as the Ohio Board of Regents).

In addition, many of the individual nursing programs are accredited by nationally recognized professional associations, including:

- The Bachelor of Science in Nursing (BSN) (https://nursing.case.edu/bsn), Master of Nursing (https://nursing.case.edu/mn) (MN), and Master of Science in Nursing (MSN) (https://nursing.case.edu/msn) programs at Case Western Reserve University are accredited by the Commission on Collegiate Nursing Education (CCNE). The next accreditation is due in 2021.

- Commission on Collegiate Nursing Education
  One Dupont Circle NW
  Suite 530
  Washington DC 20036
  202-887-6791
  http://www.aacn.nche.edu/ccne-accreditation

- The Post-Graduate APRN Certificate (https://nursing.case.edu/programs/certificate) and Doctor of Nursing Practice (DNP) programs (https://nursing.case.edu/dnp) at Case Western Reserve University are accredited by the Commission on Collegiate Nursing Education (CCNE). The next accreditation is due in 2026.

- Commission on Collegiate Nursing Education
  One Dupont Circle NW
  Suite 530
  Washington DC 20036
  202-887-6791
  http://www.aacn.nche.edu/ccne-accreditation

The nurse anesthesia program (https://nursing.case.edu/msn/anesthesia) is accredited by the Council on Accreditation of Nurse Anesthesia Education Programs (COA). The last accreditation was in 2012. The next accreditation is due in 2020.

- Council on Accreditation of Nurse Anesthesia Educational Programs
  222 South Prospect Avenue
  Park Ridge, Illinois 60068-4001
  847-655-1160
  accreditation@coa.us.com (info@aana.com)
  http://home.coa.us.com/Pages/default.aspx

The nurse midwifery program (https://nursing.case.edu/msn/midwifery) is accredited by the Accreditation Commission for Midwifery Education (ACME) (formerly ACNM Division of Accreditation) in 2015. The next accreditation is due in 2025.

- Accreditation Commission for Midwifery Education (ACME)
  8403 Colesville Road, Ste 1550
  Silver Spring, MD 20910-6374
  240-485-1800
  info@acnm.org
  http://www.midwife.org/

**Approved Programs**

The Bachelor of Science in Nursing (BSN) (http://fpb.case.edu/BSN) and Master of Nursing (MN) (https://nursing.case.edu/mn) programs (https://nursing.case.edu/mn) are approved by the Ohio Board of Nursing. The last visit for the BSN program was in fall 2015, the next visit is due in 2017. The last visit for the MN program was in 2012, and the next visit is due in 2017.

- Ohio Board of Nursing
  17 South High Street
  Suite 400
  Columbus, OH 43215-7410
  614-466-3947
  info@nursing.ohio.gov

**Facilities**

**Instructional Facilities**

With a highly qualified faculty engaged in teaching, research, and community service, FPB offers high quality academic programs. Instruction includes lectures, seminars, individual conferences and small group discussions, and clinical experiences. Modern research and educational facilities include computer and skills laboratories.

**Clinical Facilities**

Instructional facilities are abundant and varied. University Hospitals Cleveland Medical Center (http://www.uhhospitals.org) is a 1,032-bed tertiary, academic medical center specializing in adult/pediatric medical
and surgical specialties and is an aggregate of specialized hospitals that includes Alfred and Norma Lerner Tower, Samuel Mather Pavilion and Lakeside Hospital for adult medical/surgical care; Rainbow Babies and Children's Hospital; University MacDonald Women's Hospital; Seidman Cancer Center; University Psychiatric Center-Hanna Pavilion, University Hospitals Institute for Health Care Quality & Innovation, skilled nursing and rehabilitation services and home health care. University Hospitals is part of the University Hospitals Health System with services provided at 150 locations in 40 northern communities. University Hospitals Cleveland Medical Center is also the primary affiliate of Case Western Reserve University. Together, they form the largest center for bio-medical research in the state of Ohio.

The Cleveland Clinic Health System (https://my.clevelandclinic.org) has 1,440 beds on Cleveland Clinic main campus and 4,435 beds system-wide and is comprised of the Cleveland Clinic main campus, Cleveland Clinic Children's Hospital located within the main campus, Euclid Hospital, Fairview Hospital, Hillcrest Hospital, Lakewood Hospital, Lutheran Hospital, Marymount Hospital, Medina Hospital, South Pointe Hospital, Hillcrest Hospital, Ashtabula County Medical Center, Avon Hospital, Cleveland Clinic Florida (Weston, West Palm Beach), Lou Ruvo Center for Brain Health, Las Vegas, Nevada and The Glickman Urological & Kidney Institute in Las Vegas, and Cleveland Clinic Abu Dhabi, Cleveland Clinic London, Cleveland Clinic Canada. The system also includes Akron General Health System, Visiting Nurse Service and Affiliates, Hospice of VNS, Lodi Community Hospital, Edwin Shaw Rehabilitation Institute, an outpatient clinic in Toronto, Ontario and three health and well centers. It is nationally recognized as one of the top medical centers in the US and the world, particularly in technological and management systems and in the treatment of cardio-vascular disease.

MetroHealth Medical Center (https://www.metrohealth.org) is a 642-bed hospital that includes a Level I Adult Trauma, Level II Pediatric Trauma Center, and a verified regional Burn Center, a skilled nursing facility and more than 25 locations throughout Cuyahoga County with more on the way. MetroHealth is one of three teaching hospitals that make up the Case Western Reserve University Integrated Surgical Program. Annually, MetroHealth medical center handles more than one million patient visits including more than 100,000 in the Emergency Department, one the busiest in the country. The John A. Gannon Comprehensive Burn Care Center (https://www.metrohealth.org/burn) is one of only two burn centers in Ohio treats more than 1,700 outpatient and inpatient burn injuries every year. The 27-bed Surgical Intensive Care Unit admits more than 2,000 critically ill surgical patients per year. The Elisabeth Severance Prentiss Center at MetroHealth is a long term skilled nursing facility. In 2014 the Centers for Disease Control designated MetroHealth as an official Ebola Treatment Center, the only one in Ohio.

The Louis Stokes Cleveland Veterans Administration Medical Center (https://www.cleveland.va.gov) (VAMC) is one of five facilities constituting the VA Healthcare System of Ohio. A full range of primary, secondary and tertiary care services are offered to an eligible Veteran population covering 24 counties in Northeast Ohio. Care is provided to more than 112,000 Veterans each year through an inpatient tertiary care facility (Wade Park). With 17 locations of care, including 13 outpatient clinics, two community resource and referral centers, a psychosocial resource rehabilitation center, a chronic dialysis center and an ambulatory surgery center, the Northeast Ohio VA Healthcare System's quality services are easily accessible to Veterans in 24 counties.

Additional opportunities are available in a variety of health, social, and educational agencies. These include, for example, Benjamin Rose Institute, Hospice of the Western Reserve, Judson Park Retirement Community, The Cleveland Visiting Nurses Association, Cleveland Public Health Department, and many others.

Libraries

The Kelvin Smith Library (http://library.case.edu/ksl/aboutus), a 144,000 square foot building completed in 1996, houses most of the collections of Case Western Reserve University. This includes over 1,290,000 monographs, 7,363 serial titles, U.S. Government publications, company annual reports, newspapers, CDs, technical reports, over 12,000 DVDs and videos, and more. The library enables users to integrate both traditional resources and state-of-the-art technology into teaching, research, and learning. A variety of seating styles accommodates 900 people and provide electrical ports for connecting personal laptop computers. Case Western Reserve’s wireless network enables personal laptops to have internet access throughout the library. Two multimedia rooms include scanners and sound and video digitizers. Available are individual study spaces, meeting rooms, conference areas, and social gathering places.

Thirty miles of compact movable shelving allows the library to keep much of its collection onsite for immediate access to print materials. The user-friendly interface to the online catalog, databases, and other resources allows library staff to focus their attention on working in-depth with faculty and students.

In addition to the Kelvin Smith Library, students and faculty have access to the following libraries located on campus: the Cleveland Health Sciences Libraries, supporting programs in dentistry, medicine and nursing; the School of Law Library; the Lillian and Milford Harris Library in the Mandel School of Applied Social Sciences; the Kulas Music Library; and the Astronomy Library. Altogether, collections at the Case Western Reserve libraries encompass more than 1.8 million volumes, nearly 14,000 serials and periodicals, and a wide range of electronic information resources, including a CD-ROM reference database that is accessible through the Case Western Reserve network. These include OhioLINK, a state-funded network that links the libraries of 17 public universities, 23 community/technical colleges, 44 private colleges, and the State Library of Ohio and also offers access to research databases and other information resources.

The Health Sciences Libraries, which consist of the Health Center Library and the Allen Memorial Library, serve as the major libraries for holdings related to nursing, medicine, dentistry, nutrition, and biology. The Health Center Library adjacent to the School of Nursing houses nearly 350,000 volumes, 2,780 current periodicals, and audiovisual materials. Approximately 8,800 volumes are specifically nursing texts, and more than 100 journals are nursing publications. The library also houses a historical collection of nursing materials. The most current and heavily used books are placed on reserve to insure their availability to students. Faculty also place materials on reserve for use in the library. There are 18 public workstations to access the internet, and the library also provides wireless access for those with properly-equipped laptop computers.

FPB School of Nursing Information Technology Services

The Frances Payne Bolton School of Nursing has an assigned Information Technology Services group. This group is a part of University Technology (UTech (https://case.edu/utech)) Division; they manage and oversee all computer related operations within the school. Furthermore, the team assists faculty, staff and students with any computer problems, issues, needs, or equipment purchase. This group also manages the FPB Help Desk, provides troubleshooting of problems, and repairs to all school-owned equipment. There are two computer laboratories including a Cyber-Cafe (https://nursing.case.edu/students/simulation/learning-spaces) where students have access to computers and network-access
connection for hooking up their laptops along with wireless network access. The main computer lab is located on the second floor and the Cyber-Cafe is located on the ground floor. These two areas are available during the weekdays, evenings, and weekend on a 24 hours basis. The second lab (Center for Bioinformatics) is located within the Center for Nursing Education, Simulation & Innovation (https://nursing.case.edu/students/simulation) on the ground floor and is only available when not used for classroom activities during weekdays from 9:00 a.m. to 5:00 p.m.

**Center for Nursing Education, Simulation & Innovation (CNESI)**

The Center for Nursing Education, Simulation & Innovation (https://nursing.case.edu/students/simulation) is located on the ground floor and includes:

- **Center for Bioinformatics and Health Promotion**: This 24-seat multimedia classroom includes a Mondo Board, whiteboard, document camera, 35mm digitizer, LCD projector, and access to 24 internet-capable computers. This center supports all activities within the CNESI; is utilized for standardized testing, orientations, and front loading sessions; and is available between classes for students needing a computer lab for class assignments, projects, and emails.

- **Multimedia Simulation Center**: This center features four Laerdal Medical High Fidelity Human Patient Simulators: Sim-Man Essential, Sim-Baby, Sim Child, Sim Newbie, Noelle the birthing simulator, and Sim Junior as well as two pediatric and two adult Laerdal Cath-Sim Intravenous Trainers, and a large screen video display board (i.e. Mondo Board). All pre-licensure students and nurse practitioner students utilize this center on a weekly basis throughout each semester for simulation training: assessing normal and abnormal heart and lung sounds on human patient simulators; practicing various skills on task trainers; viewing skills and simulation videos; and, conducting pediatric and obstetric lab sessions.

- **Physical Assessment Center**: This center is used by pre-licensure students (BSN and MN) learning physical assessment skills and by our advanced practice students when learning advanced physical assessment. The room is fully equipped with six Midmark electronic physical exam tables that have inclining head rests, extended leg supports, storage drawers, and optional stirrups. To ensure privacy, the center has 10 three-paneled privacy screens that have wheels for ease of movement and flexibility for any lab. Our physical assessment center has 20 Welch Allyn Diagnostic kits. We also have 20 various-sized blood pressure kits for student use both in the lab and for overnight practice at home. The Physical Assessment Center houses an academic version of the Pyxis Medication dispensing system, bar coding techniques, synthetic medications, medical equipment, task trainers, breast and prostate models, and a DVD library to support our undergraduate and graduate lab sessions.

- **Private Exam Room**: This single exam room is used for student practice and testing. It contains an exam table, white board, side table and chair, Snellen eye chart, standing scale, and built in otoscope and ophthalmoscope. The room has two ceiling mounted cameras allowing faculty to record exemplars, give feedback on final examinations, and provide the opportunity to practice and review communication and assessment skills with standardized patients.

- **Clinical Teaching Center**: This center is comprised of 6 hospital patient beds with static Laerdal Medical manikins arranged to simulate an ambulatory clinic, a medical-surgical unit, and intensive care unit. This center contains many of the common devices seen in the hospital including a Hoyer lift, Geri chair, wheel chairs, canes, crutches, linen cart, ventilator, and head wall units to simulate oxygen delivery and wall suction. Our pre-licensure students use this center to learn every nursing skill from hand washing and bed making to wound irrigation and managing a ventilated patient. The center also has three medication carts, and three supply carts that contain IV tubing, IV solutions, dressing supplies, catheters, chest tubes, Foley catheters, sterile gloves, sterile gowns, bed pans, urinals, and tracheostomy supplies.

- **Perioperative Center**: This center is utilized by our BSN students and Nurse Anesthesia Students and contains a fully functioning Steris 3080 operating room table and fluid/blanket warmer, a full set of surgical instruments, back and gown tables, locked operating room cabinets, pulse oximeters, and a non-functioning anesthesia machine, endoscopy, and Bovie machine. Students learn basic hand on skills related to perioperative nursing.

- **Communication Center**: This center, with seating for 10, contains a Mondo Board, white board, and has two ceiling mounted cameras which provide video recording capabilities. This center is used with all levels of students to practice standardized patient interviews, family counseling sessions with standardized patients, clinical post conferences, seminar discussions, small group presentations, student advising and evaluations, and USNA and GNSA sponsored activities.

**Dorothy Ebersbach Academic Center for Flight Nursing and High Fidelity Helicopter Flight Simulator**: Acute care nurse practitioner (ACNP) students, specializing in flight nursing at Case Western Reserve University trail in the nation’s first state-of-the-art simulator built in an actual Sikorsky S76 helicopter. The simulator creates the sense of treating critically injured patients from takeoff to landing.

The helicopter simulator was installed at the university’s Cedar Avenue Service Center in a new classroom designed for the Frances Payne Bolton School of Nursing’s Dorothy Ebersbach Academic Center for Flight Nursing Program.

The helicopter features some of the most advanced medical equipment with authentic aerial views projected within the windows and movement that mimics changing altitudes and weather conditions throughout the flight. The learning environment allows students to experience the physical confines of an actual helicopter while practicing the delivery of patient care to high fidelity human patient manikins.

**Administration**

Mary E. Kerr, PhD, RN, FAAN, FCCM  
(Case Western Reserve University)  
*Dean and the May L. Wykle Endowed Professor*

Mary Terhaar, DNSc, RN, ANEF, FAAN  
(The Catholic University of America)  
*Associate Dean for Academic Affairs; Arline H. and Curtis F. Garvin Professor of Nursing*

Shirley Moore, PhD, RN, FAAN  
(Case Western Reserve University)  
*Associate Dean for Research; Edward J. and Louise Mellen Professor in Nursing*

Susan Frey, MAFIS  
(Cleveland State University)  
*Associate Dean for Finance and Administrative Services*
David Pratt, BS  
(John Carroll University)  
*Associate Dean of Development & Alumni Relations*

Sara Douglas, PhD, MSN, RN  
(Illinois State University)  
*Assistant Dean for Research; Arline H. and Curtis F. Garvin Professor in Nursing Excellence*

Margaret Roudebush, MNO  
(Case Western Reserve University)  
*Assistant Dean for Research Administration*

Amelia Bieda, PhD, APRN, PNP-BC, NNP-BC  
(Case Western Reserve University)  
*Assistant Professor; Director, BSN Program*

Jesse Honsky, DNP, MSN, MPH, RN  
(Case Western Reserve University)  
*Instructor; Assistant Director, BSN Program*

Molly J. Jackson, DNP, APRN, A-GNP, A-CHPN  
(Case Western Reserve University)  
*Instructor; Director, Graduate Entry (MN) Program*

Latina Brooks, PhD, CNP  
(Case Western Reserve University)  
*Assistant Professor; Director, MSN Program*

Patricia Higgins, PhD, RN, FGSA  
(Case Western Reserve University)  
*Associate Professor; Director, Post-Master’s DNP Program*

Jaclene A. Zauszniewski, PhD, RN-BC, FAAN  
(Case Western Reserve University)  
*Kate Hanna Harvey Professor in Community Health Nursing; Director, PhD Program*

Elizabeth A. Madigan, PhD, RN, CNE, FAAN  
(Case Western Reserve University)  
*Independence Foundation Professorship in Nursing Education; Head, PAHO/WHO Collaborating Center*

Diana L. Morris, PhD, RN, FAAN, FGSA  
(Case Western Reserve University)  
*Florence Cellar Associate Professor in Gerontological Nursing; Executive Director of the University Center on Aging & Health*

Evelyn G. Duffy, DNP, AGPCNP-BC, FAANP  
(Case Western Reserve University)  
*Associate Professor; Associate Director of the University Center on Aging and Health*

Camille Warner, PhD  
(Case Western Reserve University)  
*Assistant Professor; Associate Director of the University Center for Aging and Health*

Celeste M. Alfes, DNP, MSN, RN, CNE  
(Case Western Reserve University)  
*Associate Professor; Director, Center for Nursing Education, Simulation, and Innovation*

Barbara Daly, PhD, RN, FAAN  
(Bowling Green State University)  
*Gertrude Perkins Oliva Professor in Oncology Nursing*

Joachim Voss, PhD, RN, FAAN  
(University of California San Francisco)  
*Sarah Cole Hirsh Professor of Nursing; Director, Sarah Cole Hirsh Institute for Best Nursing Practices Based on Evidence*

Brigid L. Mercer, BS  
(Ohio State University)  
*Senior Director Alumni Relations and Development*

Rachel Grdina, MSSA  
(Case Western Reserve University)  
*Director International Programs and PAHO/WHO Collaborating Center*

Teona C. Griggs, M.Ed., MA  
(Cleveland State University)  
*Director Student Services, Diversity, and Inclusion*

Dedra Hanna Adams, MA, MPA  
(Cleveland State University)  
*Director Financial Aid*

Megan Juby, BA  
(John Carroll University)  
*Director Development*

Ivy Ko, BA  
(Cleveland State University)  
*Director Finance*

Kristi Lehmer, MBA  
(Thomas More College)  
*Director Recruitment and Enrollment*

Samira Hussney, MPH  
(Case Western Reserve University)  
*Director International Programs & PAHO/WHO Collaborating Center*

Caron Baldwin, MCSE  
(Ohio Wesleyan University)  
*Director Information Technology*

Helen Jones-Toms, MNO  
(Case Western Reserve University)  
*Director Marketing & Communication*

Tiffany Cooper, MBA  
(Ursuline College)  
*Director Administrative Operations and Executive Support*

Kimberly Cornuelle-Marks, BS  
(Ohio University)  
*Assistant Director Marketing & Communications and Webmaster*

Mary Clark, BS  
(Indiana University in Bloomington)  
*Assistant Director Alumni and Donor Relations*

Sally Garrett Karyo, MHA  
(Pennsylvania State University)  
*Assistant Director Center for Research and Scholarship*
Student Learning Outcomes

- Teaches and counsels individuals, families and other groups about health, illness and health seeking behaviors
- Critiques and applies research findings to clinical practice
- Provides direct patient care and assumes leadership role in directing nursing care to individuals, groups and families
- Participates and assumes beginning leadership roles
- Uses principles of ethics and the professional code as a framework for decision making
- Works effectively as a member of an interdisciplinary health care team
- Uses effective communication techniques with diverse clients, colleagues, and information systems
- Describes process of health care policy development

Degree Requirements (https://nursing.case.edu/bsn)

Candidates for the Bachelor of Science in Nursing degree must complete the following:

1. Minimum of 125.5 hours as specified by the requirements with a 2.000 GPA
2. A minimum of C for all courses taken in nursing and science courses counting toward the major
3. A minimum of 50 credit hours in 300 and 400 level courses
4. The SAGES General Education Requirements for the School of Nursing

For those with experience in the armed forces of the United States, or in the National Guard or in a reserve component, the Graduate Entry/ MN or BSN program will (a) Review the individual's military education and skills training; (b) Determine whether any of the military education or skills training is substantially equivalent to the curriculum established in Chapter 4723-5 of the Ohio Administrative Code; and (c) Award credit to the individual for any substantially equivalent military education or skills training. (In accordance with Ohio Revised Code 4723-5)

Progression in the BSN Program

Progression in the Bachelor of Science in Nursing program is contingent upon satisfactory academic achievement in all required courses. To maintain satisfactory academic standing, students must attain a GPA of 2.000 or above by the end of their junior year and must obtain a C or above in all nursing and science courses counting toward the major. Students who receive two unsatisfactory grades (D or F) in nursing and/or natural and behavioral science courses may be subject to separation from the school of nursing. See the Undergraduate Student Handbook (https://nursing.case.edu/students/student-resources/student-handbook) for a description of the criteria for academic standing.

Students who receive a grade of Incomplete (I), given at the discretion of the instructor for the course, must complete course requirements by the eleventh week of the following semester. It is the student's responsibility to notify the instructor of the circumstances preventing completion of all assigned work. In the absence of notification or adequate justification, the instructor may give the student a final grade that assumes a failing grade for the missing work. If a student fails to submit the work required for removing the Incomplete by the date established or by the eleventh week of the following semester, the instructor may give the student a final grade that assumes a failing grade for the missing work. The grade will convert from I to F when the deadline for making up incomplete grades from a previous semester has passed.

Students who receive a grade below C for a nursing course must register for that course the next semester that it is offered. If the student fails to meet the University's requirement for good academic standing, the student is placed on academic probation. If the GPA does not improve upon satisfactory academic achievement in all required courses. To progress in the BSN Program, students must attain a GPA of 2.000 or above by the end of their junior year and must obtain a C or above in all required courses. To maintain satisfactory academic standing, students must attain a GPA of 2.000 or above by the end of their junior year and must obtain a C or above in all nursing and science courses counting toward the major.

Curriculum (https://nursing.case.edu/bsn/curriculum)

This four-year baccalaureate program for high school graduates leads to a BSN degree. Upon successful completion of the program, graduates will be eligible to sit for the NCLEX examination (http://www.ncsbn.org)
for licensure as a Registered Nurse (RN). A sample study plan also demonstrates how a BSN student might schedule the required courses.

The FPB School of Nursing has the right to determine a student’s readiness to sit for the NCLEX-RN examination and the right to restrict testing until the student demonstrates a readiness to pass this examination. This examination is given by State Boards of Nursing, and satisfactory completion of this examination enables the graduate to practice as an RN in the state for which the examination was taken.

The BSN program includes nursing, science and liberal arts courses. A minimum of 125.5 credit hours, with at least 50 credits from upper division courses, are required for award of the BSN degree. Students must meet the University requirements for graduation. The ratio of clinical hours to credit hours is 4 to 1, and for laboratory hours, it is 2 to 1. The program plan for entry-level students to the BSN program is as follows:

<table>
<thead>
<tr>
<th>Class</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td><strong>Freshman</strong></td>
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<tr>
<td>Foundations of the Discipline (NURS 110)</td>
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<tr>
<td>Foundations of Practice (NURS 111)</td>
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<tr>
<td>Principles of Biology (BIOL 114)</td>
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<tr>
<td>Introduction to Human Anatomy and Physiology I (BIOL 116)</td>
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<tr>
<td>SAGES University First Seminar</td>
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<tr>
<td>GER General Education Requirement</td>
<td>3</td>
<td></td>
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<tr>
<td>BCLS and First Aid for Health Care Providers (NURS 277)</td>
<td>0</td>
<td></td>
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</tr>
<tr>
<td>Nursing Informatics 1: Introduction (NURS 120)</td>
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<tr>
<td>Foundations of the Practice II (NURS 122)</td>
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<tr>
<td>Applied Nutrition in Health and Disease (NURS 201)</td>
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<tr>
<td>Health Care in the Community (NURS 160)</td>
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<tr>
<td>Introduction to Human Anatomy and Physiology II (BIOL 117)</td>
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<td>SAGES University Seminar</td>
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<tr>
<td>Concepts for a Molecular View of Biology I (CHEM 119)</td>
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<td>Year Total:</td>
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<th><strong>Sophomore</strong></th>
<th>Units</th>
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<th>Spring</th>
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<tr>
<td>Nursing Care of the Adult 1 (NURS 230)</td>
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<tr>
<td>Introduction to Pharmacology 1 (NURS 211)</td>
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<tr>
<td>Aging in Health and Illness (NURS 250)</td>
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<tr>
<td>Teaching/Learning in the Community (NURS 210) (OR NURS 260 Process Change in the Community)</td>
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<tr>
<td>Concepts for a Molecular View of Biology II (CHEM 121)</td>
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<tr>
<td>SAGES University Seminar</td>
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<td></td>
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<tr>
<td>Medical Microbiology, Immunity, and Infectious Disease (NURS 342)</td>
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<tr>
<td>Psychiatric-Mental Health Nursing (NURS 317)</td>
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<td>Nursing Care of the Adult 2 (NURS 240)</td>
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<td>Human Development: Medical and Social (SOCI 203)</td>
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<th><strong>Junior</strong></th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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</thead>
<tbody>
<tr>
<td>Parents and Neonates in Health and Illness (NURS 315) &amp; Infants, Children, and Adolescents in Health and Illness (NURS 316) or NURS 338 and NURS 339</td>
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<td>Basic Statistics for Social and Life Sciences (STAT 201)</td>
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<td>Leadership in the Community (NURS 310) (OR NURS 360 Process Change in the Community)</td>
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<td>GER General Education Requirement</td>
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<tr>
<td>BCLS and First Aid for Health Care Providers (NURS 277)</td>
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<td></td>
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<tr>
<td>Theoretical and Evidence Bases for Best Practice in Nursing (NURS 320) (Sages Departmental Seminar)</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Care of the Adult and Older Adult with Complex Health Alterations (NURS 338) &amp; Care of the Perioperative Patient (NURS 339) or NURS 315 and NURS 316</td>
<td>8-9</td>
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<tr>
<td>Nursing Informatics 2 (NURS 345)</td>
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<td>GER General Education Requirement</td>
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<td>Process Change in the Community (NURS 360) (or NURS 310 Leadership in the Community)</td>
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<tr>
<td>Information Technologies in Health (NURS 370)</td>
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<td>Public Health Nursing (NURS 371)</td>
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<td>Health in the Global Community (NURS 372)</td>
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<td>Global Health Practicum (NURS 373)</td>
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<tr>
<td>Issues and Ethics in Health Care (NURS 343)</td>
<td>2</td>
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<tr>
<td>Concepts of Management and Leadership (NURS 341)</td>
<td>3</td>
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</tr>
<tr>
<td>Senior Preceptorship: NURS 350, NURS 352, NURS 354, NURS 356</td>
<td>8</td>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Total Units in Sequence:</td>
<td>124.5-126.5</td>
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</tr>
</tbody>
</table>

40 General Education Requirements
86 Nursing Requirements

**Advising**

In addition to your Sages advisor, each freshman nursing student will have a first year nursing advisor assigned to them. This is to assure a smooth transition during freshmen year. Athletes who are also majoring in nursing, will have a specific nursing advisor throughout their four years.
Graduate Entry Nursing Program

https://nursing.case.edu/mn/
Phone: 216.368.8858
Molly J. Jackson, DNP, AGNP-C, ACHPN, Program Director mj22@case.edu

The Graduate Entry Nursing Program is designed for individuals who hold at least a BA/BS in a non-nursing major and whose career and educational goals include nursing practice at the advanced level. All applicants are admitted to two components of the program (https://nursing.case.edu/mn): (https://nursing.case.edu/programs) pre-licensure (leading to the Master of Nursing, or MN) and, advanced nursing practice (leading to the Master of Science in Nursing, or MSN).

Following completion of the MN degree, students may pursue the MSN degree or may apply for the MSN-DNP, PhD or DNP/PhD programs. Refer to the MSN, DNP, and PhD websites for information about these programs. Certain MSN majors have separate RN experience requirements and/or admission process.

During the pre-licensure MN, students earn approximately 15 credits applicable to the curriculum of most MSN majors (in place at the time of enrollment in the MN program). The program has an innovative quality and safety component (https://nursing.case.edu/research/centers) woven throughout the curriculum, emphasizing the importance of the patient experience.

MN Program Student Learning Outcomes

The MN (Master of Nursing) is an advanced generalist nursing degree awarded to those who satisfactorily complete the required curriculum. The program outcomes for MN Students are as follows:

Quality Improvement: Leads inter-professional, culturally-sensitive, and evidence-based initiatives within organizations and systems to continuously improve the safety and quality of healthcare.

Research and Scholarship: Initiates use of theory and research to identify clinical problems or solutions, participates in scientific inquiry, and translates scholarship into practice.

Nature of Practice: Assumes the direct and indirect roles and functions of advanced nursing practice to promote health, prevent illness, and improve the health of patients and populations.

Leadership: Promotes implementation of the full scope of nursing practice and assumes leadership positions in employer, professional, or community organizations at the local/state/national level.

Ethics: Incorporates ethical principles in complex situations of advanced nursing practice and clinical inquiry.

Collaboration: Collaborates with other health care professionals to initiate intra- and/or interprofessional teams to enhance practice and patient/population health outcomes.

Communication: Integrates information, technology, and practice guidelines to promote effective communication among patients and colleagues within health care systems.

Advocacy and Policy Development: Advocates for the development of health and social policy to improve health and practice by community engagement and participating in employer and professional organizations.

Degree Requirements

Time Frame for Completion of Degree

• Completion of MN degree. MN students must complete the program within 4 years of initial enrollment. Students who do not complete the MN curriculum within 4 years are required to reapply for the program.
• Records of students who do not complete their program within the specified time frame will be re-evaluated in terms of the curriculum in effect at the time of review. The student may be required to take additional course work to graduate.
• Completion of the MSN, DNP, or PhD; refer to policies for those programs.
• Students follow the curriculum of their MSN major in effect at the time they begin the MN program.

For students with experience in the armed forces of the United States, or in the National Guard or in a reserve component, the Graduate Entry/MN or BSN program will (a) Review the individual's military education and skills training; (b) Determine whether any of the military education or skills training is substantially equivalent to the curriculum established in Chapter 4723-5 of the Ohio Administrative Code; and (c) Award credit to the individual for any substantially equivalent military education or skills training. (In accordance with Ohio Revised Code 4723-5)

Progression in the MN Program

Satisfactory Academic Standing

Progression in the MN phase of the Graduate Entry Nursing Program is contingent upon satisfactory achievement in all required courses. To maintain satisfactory academic standing, students enrolled for the pre-licensure (Master of Nursing-MN) component of the Graduate Entry Nursing Program must attain and maintain a GPA of 3.0 or above. C, the lowest passing grade, is viewed as borderline performance. An overall GPA of 3.0 is required to progress to the post-licensure component of the Graduate Entry Nursing Program. If a student’s semester GPA is less than 3.0 or the overall GPA is less than 3.0, the student will be placed on probation and an individualized plan will be developed and documented. The student will be removed from probation when the overall GPA is 3.0 or higher. If the student is on probation for two semesters, the student’s record will be reviewed by the Executive Committee to determine whether extenuating circumstances warrant an additional semester of probation or whether the student should be separated from the program.

When a student receives a grade of F for a required course, the student must register for that course the next semester in which the course is available. Refer to the Student Handbook (https://nursing.case.edu/students) for more information on repeating a course with an F grade and the GPA. Graduate Entry students who receive two failing grades indicating unsatisfactory performance (F, NP, or U) in required courses will be separated from Frances Payne Bolton. Progression from one semester to the next in the MN Program is contingent upon passing grades in all courses taken in the preceding semester.

The grade of Incomplete (I) will be given at the discretion of the instructor for work not completed in the semester. The “Arrangement to Resolve a Grade of Incomplete” form must be completed prior to the end of the semester, or the instructor may assign a grade of U or F. A grade of Incomplete must be removed by the end of the semester following the one in which the courses was taken or the next semester that the course is given or before the student enrolls in a course for which the initial course is a prerequisite. No credit is given for a grade of Incomplete. The grade of Incomplete will remain a permanent part of the transcript if the
student fails to complete course requirements within the next semester, unless alternative arrangements are approved in writing.

Graduate Entry students pursuing a post-licensure degree must meet all progression requirements of the degree program in which they are enrolled (MSN (p. 561), DNP (p. 568), or PhD (p. 570)). Refer to those sections of the Bulletin for further information.

Curriculum
Students may petition for the Master of Nursing (MN) degree upon successful completion of all courses in the MN curriculum (see below). Successful completion requires a grade of at least C in each course and an overall GPA of at least 3.0. See Graduate Entry Nursing Program Policy on Progression. Students must meet all University requirements for graduation.

The ratio of credit hours to clock hours is: didactic and seminar, 1:1; lab, 1:2; and clinical, 1:4.

Curriculum 2016-2018 - 71.5 total credit hours (Curriculum for 2017-2019 follows).

<table>
<thead>
<tr>
<th>Units</th>
<th>First Year</th>
<th>Units</th>
<th>Second Year</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td>Introduction to the Discipline and Practice of Nursing (NUMN 401)</td>
<td>6.5</td>
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<tr>
<td>Pharmacology for the Advanced Generalist Nurse (NUMN 402)</td>
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<td>3</td>
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<tr>
<td>Introduction to Nursing Informatics (NUMN 403)</td>
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<td>1</td>
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<tr>
<td>Health Assessment for the Advanced Generalist Nurse (NUMN 410)</td>
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<td>2.5</td>
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<tr>
<td>Introduction to Public Health Nursing (NUMN 411)</td>
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<td>3</td>
<td></td>
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<tr>
<td>Issues and Ethics in Health Care (NUMN 413)</td>
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<td>2</td>
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<tr>
<td>Pathophysiology for the Advanced Generalist Nurse (NUMN 405)</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Nursing Care of Older Adults in Health and Illness (NUMN 406)</td>
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<td>2.5</td>
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<td>Acute Care Nursing of the Adult (NUMN 407)</td>
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<td>Health Promotion Across the Life Span (NUNP 410)</td>
<td></td>
<td>2</td>
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<tr>
<td>Inquiry I - Theoretical Foundations (NURS 405)</td>
<td></td>
<td>2</td>
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<td>Year Total:</td>
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<tr>
<td>Concepts in Nursing Management (NUMN 414)</td>
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<tr>
<td>Parents and Neonates in Health and Illness (NUMN 415)</td>
<td>4.25</td>
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<tr>
<td>Children and Families in Health and Illness (NUMN 416)</td>
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<tr>
<td>Psychiatric Mental Health Nursing (NUMN 417)</td>
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<tr>
<td>Inquiry II - Research Process (NURS 425)</td>
<td>3</td>
<td></td>
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<tr>
<td>Advanced Generalist: Health Policy, Advocacy, and Economics (NUMN 409)</td>
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<tr>
<td>Intro to Critical Care Nursing (NUMN 418)</td>
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<td>Advanced Generalist Leadership Practicum (NUMN 419)</td>
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<td>Psychosocial and Spiritual Dimensions of Advanced Nursing Practice (NURS 431)</td>
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<td>Year Total:</td>
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Total Units in Sequence: 71.5
Credits Toward the MSN Earned in the Master of Nursing Curriculum (2016-2019)

Students who successfully complete the Master of Nursing curriculum and are awarded the MN degree have earned the following credits applicable toward most MSN majors for the MSN degree (in effect at the time of enrollment in the MN program).

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>NURS 405</td>
<td>Inquiry I - Theoretical Foundations</td>
<td>2</td>
</tr>
<tr>
<td>NURS 425</td>
<td>Inquiry II - Research Process</td>
<td>3</td>
</tr>
<tr>
<td>NURS 502</td>
<td>Inquiry III - Evidence-Based Nursing Practice</td>
<td>2</td>
</tr>
<tr>
<td>NUNP 410</td>
<td>Health Promotion Across the Life Span</td>
<td>2</td>
</tr>
<tr>
<td>NURS 431</td>
<td>Psychosocial and Spiritual Dimensions of Advanced Nursing Practice</td>
<td>2</td>
</tr>
<tr>
<td>NURS 444A</td>
<td>Ethical and End of Life Issues in Advanced Nursing Practice (waiver based on grade in NUMN 413)</td>
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</tr>
<tr>
<td>NURS 451</td>
<td>Leadership for Quality Healthcare within Organizations and Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

Approval of RN Licensure Applications

The School of Nursing has the right to determine a student’s readiness to sit for the NCLEX-RN exam and also reserves the right to restrict testing until the student demonstrates a readiness to pass the examination.

In order to have the “Program Completion” section of the application for RN licensure approved by the Program Director, students must meet the following criteria:

1. Have been awarded the Master of Nursing (MN) degree.
2. Demonstrate readiness to take the NCLEX-RN examination by achieving at least a minimum score on a faculty-selected, standardized NCLEX-RN predictor exam.

Master of Science in Nursing (MSN)

https://nursing.case.edu/msn/
Phone: 216.368.8858
Latina Brooks, PhD, CNP, Program Director
latina.brooks@case.edu

The Master of Science in Nursing program prepares registered nurses for advanced practice either as a nurse practitioner, specialist, nurse midwife, or nurse anesthetist. Dual degree programs are offered in bioethics (MSN/MA), anthropology (MSN/MA), and public health (MSN/MPH). Post-master’s certificates can be provided for all programs and are crafted according to individual needs and background education.

Student Learning Outcomes

Quality Improvement

Leads inter-professional, culturally-sensitive, and evidence-based initiatives within organizations and systems to continuously improve the safety and quality of healthcare

Research and Scholarship

Initiates use of theory and research to identify clinical problems or solutions, participates in scientific inquiry, and translates scholarship into practice.

Nature of Practice

Assumes the direct and indirect roles and functions of advanced nursing practice to promote health, prevent illness, and improve the health of patients and populations.

Leadership

Promotes implementation of the full scope of nursing practice and assumes leadership positions in employer, professional, or community organizations at the local/state/national level.

Ethics

Incorporates ethical principles in complex situations of advanced nursing practice and clinical inquiry.

Collaboration

Collaborates with other health care professionals to initiate intra- and/or inter-professional teams to enhance practice and patient/population health outcomes.

Communication

Integrates information, technology, and practice guidelines to promote effective communication among patients and colleagues within health care systems.

Advocacy and Policy Development

Advocates for the development of health and social policy to improve health and practice by community engagement and participating in employer and professional organizations.

Degree Requirements

The MSN program itself requires a minimum of 36 credit hours to graduate, but most majors require an average of 40 credit hours of graduate credit for the student who enters with a BSN degree. Other degree requirements must be fulfilled for those entering with the portfolio option. A maximum of nine (9) semester hours of credit in approved graduate courses, where the student obtained a grade of B or above, may be transferred to meet program requirements, and three (3) credits may be waived for a total of 12 credits. To be awarded an MSN degree, the student must have a cumulative GPA of 3.0 and received satisfactory grades in all nursing courses taken for credit as a MSN student. Degree requirements must be completed within 5 years of initial enrollment.

Path to the MSN

Students in the MSN program choose from several different majors, but virtually all students must take at least ten core courses (https://nursing.case.edu/msn/curriculum). Student must complete a required number of credit hours as well as clinical hours. Most majors require an average of 40 credit hours, usually completed in three or four semesters (including summer). MSN majors also require at least 600 or more clinical hours depending on major.

Students can choose either a part-time or full-time program, with full-time consisting of 9 or more credits per semester and part-time being anything less.
Course Grades
Progression in the MSN program is contingent on a cumulative GPA of 3.0 and passing grades in all courses (A, B, C, P, or S). If the cumulative GPA falls below 3.0 during any semester, the student will be placed on academic probation. To be removed from probation, the student must have a cumulative GPA of 3.0 or higher in the next academic semester. If the student fails to be removed from academic probation at this time, he/she may be separated from the FPB School of Nursing.

The grade of Incomplete (I) will be given at the discretion of the instructor for work not completed in the semester. The “Arrangement to Resolve a Grade of Incomplete” form must be completed prior to the end of the semester, or the instructor may assign a grade of U or F. A grade of I must be removed by the end of the semester following the one in which the course was taken or the next time the course is offered and before the student enrolls in a course for which the initial course is a prerequisite. No credit is given for an I grade. The I will remain a permanent part of the transcript if the student fails to complete course requirements within the next semester, unless alternative arrangements are approved in writing.

A student who receives a grade of F or U for a required course must register for the course the next semester it is offered to continue in the MSN program. If the grade of U or F is in a course that is not required for the MSN program, the student may register for the same course or a substitute course and achieve a passing grade to continue in the MSN program. MSN students who receive 2 failing grades (F, U, NP) will be separated from FPB.

Majors and Sample Full-Time Curriculum
Virtually all MSN students must take at least ten core courses in Professional Development, Scientific Inquiry, and Nursing Practice. Although the MSN program itself requires a minimum of 36 credit hours to graduate, most majors require an average of 50 credit hours, usually completed between 18 and 24 months, though the nurse anesthesia program requires 36 months of study. Students are required to complete 600 or more clinical hours depending on MSN major. Post-master’s certificates can be provided for all programs and are crafted according to individual needs and background education.

MSN Majors
Adult Gerontology Acute Care Nurse Practitioner (https://nursing.case.edu/msn/adult-gerontology-acnp) (AGACNP)
- Specialty: Adult Gerontology

Acute care nurse practitioners (AGACNPs) often serve as first responders in a variety of healthcare settings that include community and academic hospitals, intensive care units, outpatient clinics, and specialty practices like medical cardiology, subacute care, or trauma.

As part of FPB’s MSN program, the AGACNP major requires at least 39 credit hours of coursework and 600 hours of clinical experience. A recent year of adult intensive care (ICU) nursing experience is required prior to beginning this program.

First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>Inquiry I - Theoretical Foundations (NURS 405)</td>
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</tr>
<tr>
<td>Foundations for Adult-Gerontology Acute Care Nursing (NUNP 438)</td>
<td>4</td>
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</table>

Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Inquiry II - Research Process (NURS 425)</td>
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<tr>
<td>Year Total:</td>
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<tr>
<td></td>
<td>12</td>
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</table>

Appendix: MSN Majors and Sample Full-Time Curriculum

Adult-Gerontology Primary Care Nurse Practitioner (https://nursing.case.edu/msn/gerontology) (AGACNP)

Adult-gerontology Primary Care Nurse Practitioners provide comprehensive care, including wellness and acute and chronic illness care, to patients from late-adolescence through adulthood to the elderly. They specifically emphasize health promotion, disease prevention, and comprehensive gerontological assessment. They practice in a wide variety of locations that include hospitals, urgent and primary care settings, community clinics, long-term care facilities, and private practice.

As part of FPB’s MSN program, the adult-gero NP major requires 41 hours of coursework, plus 600 hours of clinicals. The coursework is usually completed within 18 months (four semesters) for full-time students, and courses are offered in a distance-friendly format that requires about eight trips to Cleveland.
Pediatric Nurse Practitioner (https://nursing.case.edu/msn/pediatric) (PNP)

Pediatric nurse practitioners (PNPs) are advanced degree nurses who provide primary health care for children from infancy to 21 years of age, including physical, psychosocial, and family dimensions of health. They diagnose and treat childhood illnesses, provide immunizations, perform developmental screenings and physical assessments, and much more in their objective to protect and enhance the health of children. Along with pediatricians and other providers, PNPs practice in settings such as private practice, primary care clinics, community health centers, and hospitals.

As part of FPB’s MSN program, the PNP major requires 40 credit hours of coursework, plus 600 hours of clinicals. The coursework is usually completed within 18 months (four semesters) for full-time students, and courses are offered in a distance-friendly format.

Pediatric Nurse Practitioner in Acute Care (https://nursing.case.edu/msn/pediatric-%C2%ADacute)

Acute Care Pediatric Nurse Practitioners are responsible for promoting the overall health of chronic, acute or critically ill children. In this program, you will discover best practices to diagnose and treat acute, critical, and chronic illness in children. You will also learn to coordinate interdisciplinary models of referral, relationships, ethical behavior, conflict resolutions and the implementation of health plans for critically or acutely ill children.

The pediatric nurse practitioner major in acute care, as part of FPB’s MSN program, requires 45 hours of coursework, plus over 600 clinical hours. Graduates are eligible for the certification exam conducted by the Pediatric Nursing Certification Board.

- A dual major in Pediatric Nurse Practitioner-Primary Care and Acute Care Pediatric Nurse Practitioner is available by taking only one additional course and 200 additional clinical hours.
- Post-master’s certificates can be obtained, crafted according to individual needs and background education.
- One year of recent acute care pediatric nurse experience required for admission.
<table>
<thead>
<tr>
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<th>Fall</th>
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<th>Summer</th>
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</thead>
<tbody>
<tr>
<td>Inquiry I - Theoretical Foundations (NURS 405)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Pathophysiology (NURS 453)</td>
<td>4</td>
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<tr>
<td>Advanced Health Assessment (NURS 459)</td>
<td>3</td>
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<tr>
<td>Health Promotion Across the Life Span (NUNP 410)</td>
<td>2</td>
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<tr>
<td>Development and Health Promotion in Children and Adolescents (NUNP 401)</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Inquiry II - Research Process (NURS 425)</td>
<td>3</td>
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<tr>
<td>Pharmacology and Therapeutics (NURS 430)</td>
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<td>Common and Acute Health Problems of Children (NUNP 402)</td>
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<tr>
<td>Inquiry III - Evidence-Based Nursing Practice (NURS 502)</td>
<td>2</td>
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<td>Leadership for Quality Healthcare within Organizations and Systems (NURS 451)</td>
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<td>Year Total:</td>
<td>14</td>
<td>12</td>
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<table>
<thead>
<tr>
<th>Second Year</th>
<th>Fall</th>
<th>Spring</th>
</tr>
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<tbody>
<tr>
<td>Advanced Management in Pediatric Primary Care (NUNP 403)</td>
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<td>Ethical and End of Life Issues in Advanced Nursing Practice (NURS 444A)</td>
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<tr>
<td>Health Care Delivery and Finance in Advanced Practice (NURS 444B)</td>
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<tr>
<td>Health Policy Legislation and Legal Issues in Advanced Practice (NURS 444C)</td>
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<tr>
<td>Management of Complex Acute Problems in Children I (NUNP 455)</td>
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<td>Psychosocial and Spiritual Dimensions of Advanced Nursing Practice (NURS 431)</td>
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<tr>
<td>Management of Complex Acute Problems in Children II (NUNP 456)</td>
<td>5</td>
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<tr>
<td>Year Total:</td>
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<td>11</td>
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Total Units in Sequence: 50

Neonatal Nurse Practitioner ([https://nursing.case.edu/msn/neonatal](https://nursing.case.edu/msn/neonatal)) (NNP)

Neonatal nurse practitioners (NNPs) are advanced practice nurses who focus on the management and care of fragile, critically ill, and premature infants and their parents. Their role encompasses activities that promote optimal health, detect illness, and facilitate restoration and maintenance of the health of neonates. NNPs practice in neonatal intensive care units (NICUs), which are found in children’s and large general hospitals.

Two years of NICU nursing are needed prior to beginning the NNP major. As part of FPB’s MSN program, the major requires 40 credit hours of coursework, plus 700 hours of clinicals in Level III NICUs. Full-time coursework is completed within 18 months (4 semesters).

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Total Units in Sequence: 40

Family Nurse Practitioner ([https://nursing.case.edu/msn/fnp](https://nursing.case.edu/msn/fnp)) (FNP)

Family nurse practitioners (FNPs) are advanced nurses who offer care, promote health, and treat disease in patients ranging from children to elders. They provide comprehensive wellness care as well as management of acute and chronic illnesses. FNPs practice in hospitals, urgent care and primary care settings, federally-qualified health centers, and private practice offices.
As part of the MSN program, the FNP major requires 40 credit hours of coursework, plus 600 hours of clinicals. The coursework is usually completed within 18 months (four semesters) for full-time students, and courses are offered in a distance-friendly format.

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### Total Units in Sequence: 40

**Women's Health Nurse Practitioner** ([https://nursing.case.edu/msn/womens-health](https://nursing.case.edu/msn/womens-health)) (WHNP)

Women’s health nurse practitioners (WHNPs) are experts in woman-focused health promotion and disease prevention. As specialists, WHNPs deliver comprehensive health care to women, with emphasis on reproductive and gynecologic health needs. They provide well-woman care, care during and after pregnancy, and care before and after menopause. They also care for women experiencing episodic acute or chronic illnesses. WHNPs see a broad range of patients in practice settings that include primary care centers, adolescent health centers, and private practice.

The WHNP major, as part of FPB’s MSN program, requires 38 credit hours of coursework, plus 600 hours of clinicals. With full-time enrollment, coursework is usually completed within 12 months (four semesters). Core MSN courses are offered in an intensive format ([https://nursing.case.edu/msn/womens-health](https://nursing.case.edu/msn/womens-health)) that requires limited trips to Cleveland.

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### Total Units in Sequence: 38

**Family Systems Psychiatric Mental Health Nursing** ([https://nursing.case.edu/msn/familysystems-psych](https://nursing.case.edu/msn/familysystems-psych)) (PMHNP)

In addition to the shortage of advanced practice psychiatric nurses, healthcare systems are challenged to address the needs of an increasing...
elderly population; stressed military families; families impacted by the economy, loss of employment, home foreclosure, and other stressors; and a population facing an increase in reported rates of domestic and youth violence.

The work of an advanced practice psychiatric nurse practitioner is dynamic in scope, ranging from prevention and health promotion to early detection and assessment to integration and culturally appropriate, client-centered intervention. Similarly, they can practice in a multitude of environments, including community mental health clinics; hospitals systems; private physician offices; prison systems; military bases and Veteran's Affairs Hospitals; treatment facilities; and psychiatric mental health community centers, among others.

The Family Systems Psychiatric Mental Health Nursing major, as part of the MSN program, requires 45 credit hours of coursework and 720 hours of clinicals. The coursework is usually completed within four semesters.

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Total Units in Sequence: 48-49

### Other Majors

**Nurse Anesthesia**

Nurse anesthetists are advanced practice nurses who administer all types of anesthetic for every kind of surgery or procedure. As expert clinicians primarily responsible for direct patient care, they focus on preoperative evaluation, intraoperative management, and postoperative anesthesia care.

Clinical courses for MSN nurse anesthesia students at FPB provide them with the opportunity to give direct patient care, participate in staff education programs, and identify clinical topics for research. Students work one-on-one with a clinical preceptor with expertise in nurse anesthesia. They will also take part in administering general and regional anesthesia in persons of all ages. The management of emergency operations, obstetrics, pediatrics, and neurosurgery are an integral part of the clinical experience. Graduates will be eligible to take the certification examination administered by the Council on Certification of Nurse Anesthetists.

All applicants must have at least two years of recent experience in one of the following acute care settings: recovery room, emergency room, or medical, surgical, neonatal, or pediatric intensive care or one year’s experience with certification in their respective nursing specialty (CCRN, CEN, CPAN).

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Total Units in Sequence: 40

### Nurse Midwifery ([https://nursing.case.edu/msn/midwifery](https://nursing.case.edu/msn/midwifery))

Certified nurse-midwives (CNMs) are educated in the two disciplines of nursing and midwifery and are certified according to the requirements of the American Midwifery Certification Board. CNMs manage women's health care, focusing on common primary care issues, family planning and gynecologic needs including menopause related issues, pregnancy, childbirth, the postpartum period, and care of the newborn. They practice within a healthcare system that provides for consultation, collaboration, or referral as indicated by the health status of the client, in accordance with the Standards for the Practice of Midwifery, as defined by the American College of Nurse-Midwives (ACNM).

Nurse midwife students must complete 48 credit hours of coursework as well as work individually with (a) clinical preceptors in a variety of outpatient, in-patient, and out-of-hospital settings to provide optimal care to women in the antepartum, intrapartum, (and) postpartum and non childbearing periods. Graduates will be eligible to take the certification examination administered by the American Midwifery Certification Board.

By taking NURS 559, Advanced Practice in Nursing Care of Women, students are eligible for dual certification in Women's Health.

### First Year

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<td>Advanced Midwifery (NURS 557)</td>
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<td>6</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td></td>
<td>11</td>
<td>6</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 48

### Education with Population Focus ([https://nursing.case.edu/msn/educationmajor](https://nursing.case.edu/msn/educationmajor))

Nurse Educators are prepared at the master's level and qualified to teach and develop future generations of nurses. The Nurse Educator program at FPB responds to a great demand in our community and across our state and the nation for clinical educators and preceptors. In these roles, nurse educators will advance the knowledge, skill and competence of the workforce. As clinical educators, graduates will provide opportunities for continuous learning to nurses in practice. These same graduates will also be prepared to serve as preceptors who will partner with faculty in schools of nursing to offer high quality clinical experiences in which students learn to use evidence in practice. The program places strong...
emphasis on developing strong critical thinking that is required for safe and effective practice.

Consistent with all FPB graduate programs in nursing, planned clinical experiences form a central component of the education. Students have the opportunity to complete a Teaching Practicum in one of a variety of clinical settings, from world class academic medical centers, local community health agencies, and a variety of primary care practices including federally qualified health centers. These placements are aligned with individual student’s career aspirations and afford rich opportunities to satisfy course objectives.

Students complete pathophysiology, pharmacology, physical assessment as required for advanced practice nursing. They study health promotion across the lifespan, research methods, ethics, curriculum development and evaluation of learning.

Nurse Educator students must complete 39 credit hours of coursework and graduates are eligible to take the Certification Nurse Educator examination administered by the National League for Nursing after 2 years of experience.

First Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry I - Theoretical Foundations (NURS 405)</td>
<td>2</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Advanced Health Assessment (NURS 459)</td>
<td>3</td>
<td></td>
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<tr>
<td>Health Promotion Across the Life Span (NUPN 410)</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Leadership for Quality Healthcare within Organizations and Systems (NURS 451)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethical and End of Life Issues in Advanced Nursing Practice (NURS 444A)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inquiry II - Research Process (NURS 425)</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Pharmacology and Therapeutics (NURS 430)</td>
<td>3</td>
<td>3</td>
<td></td>
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<tr>
<td>Common &amp; Acute Health Problems of the Adult and Older Adult (NUED 432)</td>
<td>3</td>
<td></td>
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<tr>
<td>Curriculum and Instruction (NUED 509)</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Inquiry III - Evidence-Based Nursing Practice (NURS 502)</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>Primary Care of the Older Adult (NUED 449)</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theoretical Foundations of Educational Testing and Evaluation (NUED 609)</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Year Total:</td>
<td>11</td>
<td>12</td>
<td>7</td>
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Second Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Management in Adult and Older Adult Primary Care (NUED 434)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Health Policy Legislation and Legal Issues in Advanced Practice (NURS 444C)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Teaching Practicum (NUUND 615)</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Year Total: 9

Total Units in Sequence: 39

Note: The Advanced Practice Core courses are co-requisites or prerequisites for the clinical nursing courses. Clinical nursing courses must be taken in the semester and sequence listed above. Clinical course availability is based upon enrollment.

Post-MSN tract will be offered to anyone who is primary care PNP certified. A gap analysis will be performed on students from other programs to assure consistency. The post-MSN Student will be required to take the acute care courses and additional clinical if needed.

Joint Degrees

MSN/PhD Dual Degree Program (https://nursing.case.edu/phd/entry-options)

The Master of Science in Nursing / PhD combined degree program provides the opportunity for students with a BSN or MN degree to pursue the PhD while earning an MSN degree in a selected major or clinical specialty along the way. Application involves a dual submission process and applicants must be accepted into both programs. For the combined MSN/PhD program, up to 8 credits of course overlap are allowed depending on the selected clinical major.

Master of Science in Nursing/Master of Arts in Anthropology (MSN/MA Anthropology) (http://anthropology.case.edu/graduate-programs/joint-programs/msn-ma)

The Master of Science in Nursing/Master of Arts in Anthropology joint degree provides students with the unique combination of cross-cultural expertise in medical anthropology and clinical expertise in nursing. Students must complete a minimum of 19 credits in nursing core courses, 12 to 22 credits in clinical major courses, and a minimum of 18 credits in anthropology courses, distributed as indicated below. The actual number of credits depends upon the major selected. This curriculum plan reflects clinical nursing majors other than nurse anesthesia and community health. Choice of electives should guarantee that minimum credit requirements are met. All students must pass the Masters Qualifying Examination in Anthropology.

Master of Science in Nursing/Master of Arts in Bioethics (MSN/MA Bioethics) (https://nursing.case.edu/msn/msnmabio)

The Master of Science in Nursing/Master of Art in Bioethics joint degree program is designed to provide nurses with the concepts essential to ethics and ethical decision-making. This program is relevant for nurses who are family advocates within health care systems. The total MSN/MA degree requirements are 53-63 credits.

Doctor of Nursing Practice

https://nursing.case.edu/dnp/

Phone: 216.368.1907

Patricia Higgins, PhD, RN, Interim Program Director

patricia.higgins@case.edu

The Doctor of Nursing Practice Program (DNP) is an innovative academic program designed to prepare nurses for leadership positions in advanced nursing practice roles. The Post-Master's DNP program is
flexible in meeting the needs of distance education students, with an innovative executive format and cohort program that has partnerships with numerous academic institutions and hospitals around the country. The DNP program admits students at two different stages in order to accommodate students with diverse educational backgrounds.

- Post-Licensure (Advanced Nursing Practice stage: MSN degree awarded). This entry point into the DNP program is designed for registered nurses entering the MSN program. Students who apply to the MSN and DNP programs at the same time follow a blended curriculum in which students begin taking DNP courses while in the masters program. Students are awarded an MSN degree when they complete MSN requirements and continue with DNP coursework. They are allowed to apply to a professional organization for certification in the advanced practice specialty and to a Board of Nursing for credentials to practice. Students in the MSN program may also apply to the DNP program during the MSN program but are required to complete courses from both programs.

- Post-Master’s DNP (Practice Doctorate stage; DNP degree awarded): This stage of the DNP program prepares nurses with MSN degrees to be clinical leaders at the absolute pinnacle of their field. Students acquire in-depth knowledge in nursing theory, research, policy, and education or management. Most DNP students at the post-master’s level are already practicing in roles as advanced practice nurses, administrators, or educators. Once they are admitted to this phase of the program, they choose one of two elective sequences: education leadership or practice leadership.

**Student Learning Outcomes**

**Scientific Underpinnings for Practice**

- Integrate nursing science and theory with knowledge and theory from ethics, the biophysical, psychosocial, cultural, and organizational sciences to develop and evaluate new practice approaches.

**Organizational and Systems Leadership for Quality Improvement and Systems Thinking**

- Demonstrate leadership in the development and evaluation of care delivery approaches that meet current and future needs of patient populations from findings of nursing and other clinical sciences, as well as organizational, political and economic sciences.

- Develop and evaluate effective strategies and ensure accountability for leading organizations, addressing quality improvement and patient safety initiatives, and managing ethical dilemmas inherent in patient care and research.

**Clinical Scholarship and Analytical Methods for Evidence-Based Practice**

- Use analytic methods to critically appraise existing evidence to determine best practices.

- Apply relevant findings and use quality improvement methods to develop recommendations to improve practice and the practice environment.

- Disseminate findings from evidence-based practice and research to improve health care outcomes.

**Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care**

- Evaluate programs that monitor outcomes of care, care systems, and quality improvement including consumer use of health care information systems.

- Provide leadership in the evaluation and resolution of ethical and legal issues within health care systems relating to the use of information, information technology, communication networks and patient care technology.

**Health Care Policy and Advocacy in Health Care**

- Demonstrate leadership in the critical appraisal, development, and/or implementation of institutional, local, state, federal, and international health policy.

**Inter-professional Collaboration for Improving Patient and Population Health Outcomes**

- Collaborate using communication, consultative, and leadership skills, with intra-professional and inter-professional teams to improve quality and safety in health care.

**Clinical Prevention and Population Health for Improving the Nation’s Health**

- Analyze scientific data and synthesize concepts related to clinical prevention and population health in developing, implementing, and evaluating interventions to address health promotion and disease prevention efforts.

**Degree Requirements**

- Post-master’s entry students must complete the DNP program within five years. Students who do not complete the DNP program within the above time frame should send a letter to the Director of the Doctor of Nursing Practice Program with a request for an extension and a proposed plan for completing of remaining requirements.

- Records of students who do not complete the program within the specified time frame will be re-evaluated in terms of the curriculum in effect at the time of review. The student may be required to take additional course work to graduate.

**Academic Performance**

Progression in the Doctor of Nursing Practice degree program is contingent upon satisfactory academic achievement in all required courses.

Doctor of Nursing Practice students must achieve a cumulative grade point average of 3.0 or above in all courses taken for credit as a DNP student at the Frances Payne Bolton School of Nursing to be awarded the DNP degree. All DNP students must successfully defend their scholarly project.

The grade of incomplete (I) will be given at the discretion of the instructor for work not completed in the semester. A grade of I must be removed by the end of the semester following the one in which the course was taken or before the student enrolls in a course for which the initial course is a prerequisite. No credit is given for an I grade. The I will remain a permanent part of the transcript if the student fails to complete course requirements within the next year and the student will be required to retake the course.

**Scholarly Project**

The DNP program culminates in successful completion of a scholarly project. The scholarly project is designed by the student in collaboration with a 3-member committee approved by the Program Director. The scholarly project must focus on an issue related to improving patient outcomes. The scholarly project can take the form of a five chapter written project or a manuscript suitable for publication. The procedures
and written product must conform to the regulations of the FPB School of Nursing.

Students must successfully defend their completed scholarly project in an "oral examination" with their committee members who are responsible for certifying that it meets acceptable scholarly standards. The defense is open to faculty and students and to those outside of the University. The committee determines the adequacy of the oral examination and written product. A student will pass if two or more of the committee members agree that the student successfully responded to questions during the defense and the written product met scholarly standards.

**Post-Master's DNP Curriculum**

Most classes are held in an intensive format (https://nursing.case.edu/dnp/cohorts), meeting for a specified number of days with additional meetings held online. A 3-credit course will meet for 5 days. Three courses are held online across the semester. Intensive sessions are given three times a year (January, May, and August) for at least two weeks. Papers and projects are due in the semester following the intensive session.

**Required Courses**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUND 450</td>
<td>Applied Statistics (Online)</td>
</tr>
<tr>
<td>NUND 504</td>
<td>Theories for Nursing Practice and Scholarship</td>
</tr>
<tr>
<td>NUND 506</td>
<td>Leadership in Organizations and Systems</td>
</tr>
<tr>
<td>NUND 508</td>
<td>Health Care Policy and Planning</td>
</tr>
<tr>
<td>NUND 510</td>
<td>Application of Health Information Technology and Systems (Online)</td>
</tr>
<tr>
<td>NUND 540</td>
<td>Practice Focused Inquiry I (NUND 450 and NUND 504 are prerequisites)</td>
</tr>
<tr>
<td>NUND 541</td>
<td>Practice-Focused Inquiry II</td>
</tr>
<tr>
<td>NUND 610</td>
<td>Translating Evidence into Nursing Practice (Online)</td>
</tr>
<tr>
<td>NUND 611</td>
<td>Practicum</td>
</tr>
<tr>
<td>NUND 619</td>
<td>Proposal Development</td>
</tr>
<tr>
<td>NUND 620</td>
<td>Scholarly Project</td>
</tr>
</tbody>
</table>

**Educational Leadership Electives**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUND 509</td>
<td>Curriculum and Instruction</td>
</tr>
<tr>
<td>NUND 609</td>
<td>Theoretical Foundations of Educational Testing and Evaluation</td>
</tr>
</tbody>
</table>

**Practice Leadership Electives**

<table>
<thead>
<tr>
<th>Credits</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUND 507</td>
<td>Management in Advanced Nursing Practice</td>
</tr>
<tr>
<td>NUND 607</td>
<td>Advanced Leadership and Management in Healthcare</td>
</tr>
</tbody>
</table>

**Student Learning Outcomes**

<table>
<thead>
<tr>
<th>Themes/Roles</th>
<th>Characteristics/Expected outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research/Knowledge Development</td>
<td>• Conduct original research&lt;br&gt;• Critique and integrate different scientific perspectives in the conduct of original research&lt;br&gt;• Lead interdisciplinary research teams and participate in team science</td>
</tr>
<tr>
<td>Leadership</td>
<td>• Understand the evolving roles and responsibilities of a nurse scholar&lt;br&gt;• Assume leadership in the conduct of culturally and linguistically appropriate scholarship&lt;br&gt;• Lead in advancing the discipline through scholarly contributions and science in the global community&lt;br&gt;• Provide career and research mentorship to others</td>
</tr>
<tr>
<td>Dissemination</td>
<td>• Communicate research through publications and presentations for professional, interdisciplinary, and lay audiences</td>
</tr>
<tr>
<td>Policy</td>
<td>• Generate and disseminate knowledge relevant to health care policy&lt;br&gt;• Understand the influence of politics and policy on knowledge generation</td>
</tr>
</tbody>
</table>

The PhD program is a post baccalaureate degree program designed to prepare scientists who initiate and conduct research relevant to nursing. Expertise in clinical nursing and competence in research are required to prepare scholars to disseminate knowledge and build programs of research. To achieve excellence in the academic program, students engage in activities consistent with the areas of research excellence of the faculty. Moreover, the faculty is committed to the intellectual growth of the student, which is achieved through mentorship and collaboration in scholarship.

The PhD student concentrates on the organization and development of knowledge requisite to nursing practice for service to a population. The population may include: age group (children, adults), focus of service (individual, family, or community) and position on the continuum of health (health and wellness, acute and chronic disruptions in health). PhD students are culturally diverse, and many develop and apply knowledge relevant to global health needs.
Degree Requirements

Our PhD in Nursing program prepares students for careers as researchers, scientists, or university-level faculty members. Students have the opportunity to participate in research that has a profound effect on the science of nursing and nursing practices. PhD students concentrate on the organization and development of knowledge requisite to nursing practice for service to a particular population. PhD students are culturally diverse, and many develop and apply knowledge relevant to global health needs.

The PhD requires a minimum of 57 semester hours, including coursework, proposal development and research and dissertation completion. The program is individualized, taking into account student interests, aspirations, and work experience. Students entering the program with a BSN who do not wish to obtain an MSN degree will have an option to take NURS 507 Clinical Knowledge and NURS 508 Context of Care; or to take 6 credits of MSN courses to ease their transition from BSN to PhD. A dual degree MSN/PhD program is available for those who also want an MSN degree.

General program requirements are listed below. Additional coursework may be required or recommended, as determined by the faculty advisor, and area of research. Courses may be taken on a full time or part time basis.

Knowledge Development/Theory Core (6 credit hours)
- NURS 506 Nursing Epistemology 3
- NURS 511 Strategies for Theory Development 3

Research Methods Core (9 credit hours)
- NURS 518 Qualitative Nursing Research 3
- NURS 530 Advanced Nursing Research Methods I 3
- NURS 531 Advanced Nursing Research Methods II 3

Statistics Core (9 credit hours)
- NURS 532 Applied Statistics (Possibility for waiver if equivalent graduate level statistics course completed within the past 5 years with a grade of B or better) 3
- NURS 630 Advanced Statistics: Linear Models 3
- NURS 631 Advanced Statistics: Multivariate Analysis 3

Support Courses (minimum 12 credit hours)
- NURS 609 Health Care Policy and Planning (Taught in an executive/intensive format) 3
- NURS 615 Topical Seminar in Health Science Research 3

Electives 3-6

Preparation for Research (minimum 3 credit hours)
- Research Practicum (240 hours required) 0
- NURS 671 Proposal Development (minimum of 3 credits required) 3

Candidacy Exam 0
Proposal Defense 0

Dissertation Research (minimum 18 credit hours)
- NURS 701 Dissertation Ph.D. 1-9
- Dissertation Fellowship (upon recommendation to the School of Graduate Studies) for a maximum of 4 consecutive semesters after completion of NURS 701

Optional PhD Education Courses

To insure that graduates from our PhD in Nursing program are prepared to assume the full faculty role upon graduation, including preparation for teaching and mentoring others, students are encouraged to take optional courses that specifically address the development of their teaching skills.

While two of these courses are taught in an intensive format, between semesters, the third course consists of a 60-hour teaching practicum.

Preparation for Nursing Education Coursework
- NURS 578 Curriculum and Instruction (3 credits)
- NURS 619 Theoretical Foundations of Testing and Evaluation (2 credits)
- NURS 621 Teaching Practicum (1-6 credits)

It is recommended that courses within this education track be integrated within the student’s planned program of study within the first two years of the program.

All coursework and the teaching practicum must be completed before the student will be advanced to candidate status.

Sample Curriculum Plans
See the website for details. (https://nursing.case.edu/phd/sample-plans)

Traditional Format Sample Plan

Students who already have earned the MSN degree can enter the PhD program directly and complete the PhD core coursework during fall and spring semesters.

- A minimum of 3 credits of proposal development is required; however, students may need more time to complete their candidacy exam and proposal development and may therefore need to take more credits of proposal development.
- Concurrent enrollment in proposal development credits and dissertation credits is not permitted.
- Full time status is defined as 9 credits per semester ONLY while students are enrolled in their coursework and prior to proposal development. However, enrollment in even a single credit of proposal development or dissertation constitutes full time study.
Fast-Track Sample Plan
Students with a BSN or equivalent can pursue the PhD degree without earning an MSN. Learn more about our Entry Options (https://nursing.case.edu/phd/entry-options).

- A minimum of 3 credits of proposal development is required; however, students may need more time to complete their candidacy exam and proposal development and may therefore need to take more credits of proposal development.
- Concurrent enrollment in proposal development credits and dissertation credits is not permitted.
- Full time status is defined as 9 credits per semester ONLY while students are enrolled in their coursework and prior to proposal development. However, enrollment in even a single credit of proposal development or dissertation constitutes full time study.
- Total required credit hours for the nursing PhD (post BSN or equivalent) = 63 credits
- BSN to PhD Transition Course Waiver form (PDF) (https://nursing.case.edu/nursing/media/nursing/pdf-doxx/BSN_PHD_Transition_Course_Waiver_Form.pdf)

Advanced Standing for DNP Graduates
Students who have earned a DNP degree within the past five years may be granted advanced standing in the PhD nursing program and qualify for a waiver of up to 9 credits.

Dual Degree Programs
MSN/PhD Dual Degree Program
Students must be accepted into both programs. They select an MSN major or clinical specialty and may take MSN and PhD courses concurrently. Up to 8 credits of course overlap are allowed, depending on the clinical MSN major.

DNP/PhD Dual Degree Program
Students must be accepted into both programs and must meet course requirements for both doctorates with an overlap of 11 credits. Students develop proposals for the DNP thesis project and PhD dissertation concurrently in order to facilitate timely completion of both degrees.

Other Student Categories
Non-Degree Students
An applicant with basic preparation in nursing may apply to register as a non-degree student for up to 9 credits. After your application is received and approved, you will receive further instructions via e-mail on how to register via the Student Information System (SIS).

For those wishing to take PhD courses, the applicant must obtain written permission from the faculty teaching the course and the PhD Program Director in the FPB School of Nursing for those taking PhD courses. Contact the Graduate Studies Office (http://www.case.edu/gradstudies) at 216-368-4390.

For those wishing to take MSN or post-MSN DNP courses, the applicant must complete our online application and receive permission from the appropriate program director before being permitted to enroll in the course. Once the application has been submitted, the student will be notified if permitted to enroll into the course.

Continuation of this status is at the discretion of FPB's administrative officer. Status as a non-degree student does not imply acceptance into FPB. If the non-degree student applies for admission to FPB, coursework completed as a non-degree student will be evaluated on an individual basis for its applicability to degree requirements within the time frame for the degree.

Clinical courses may not be taken as a non-degree student.

Special Students
Special students are those who take a series of courses designed to meet their particular career goals. These students must meet the admission requirements for the program in which the majority of classwork will be completed. Status and performance will be reviewed after one year. Students completing MSN courses to obtain a certificate in any advanced practice nursing major will be admitted as special students.

If a special student decides to pursue a graduate degree, the approval of the Associate Dean of Academic Programs must be obtained. Entrance into the degree program will be considered the date when the student enrolled in the first coursework as a special student. These courses must have been taken within the last five years. If more than five years have elapsed since the coursework as special student was done, the student must meet the current academic requirements for the major selected.

International Students
International students are welcome to enroll in any educational program. All prospective students must meet the admission requirements for the program that they select. English translations of transcripts are required. It is recommended that applications be submitted 9 to 12 months prior to the desired date of enrollment.

Each applicant for graduate programs must document the ability to speak, read, and write English as evidenced by satisfactory performance on the Test of English as a Foreign Language (TOEFL). The International English Language Testing System (IELTS) is also accepted.

Test information can be obtained at: www.toefl.org (http://www.toefl.org) and www.ielts.org (http://www.ielts.org)

Students whose native language is English are exempt. For those whose native language is not English, the minimum acceptable scores are:

- Internet-based TOEFL: 90
- Paper-based TOEFL: 577
- IELTS: 7.0
- https://nursing.case.edu/apply/international/

Additional requirements for international students:

- International students must present evidence of adequate financial resources to meet the expenses of full-time study as well as travel to and from Cleveland. Financial assistance from FPB is limited. Each student will need a sponsor who will provide full financial support. Each sponsor is required to document their ability to support the student, including costs of tuition and fees, room and meals, books, incidentals, and travel expenses. http://www.case.edu/gradstudies/new-students/important-first-steps
- For the MSN and post-graduate certificate programs, excluding the Nurse Educator option, prospective students must be eligible for
licensure as a registered nurse (RN) before enrollment. To obtain RN licensure, the student can either 1) obtain licensure in a state other than Ohio and apply for reciprocity in Ohio, or 2) sit for the licensure examination (NCLEX-RN) in Ohio. For information on how to become licensed in any state, you must obtain information from the specific state where you wish to become licensed. For the individual addresses of each State Board of Nursing, go to the National Council of State Boards of Nursing website (http://www.ncsbn.org) and then go to "Boards of Nursing."

- For additional information about obtaining a US visa visit the following site: http://www.case.edu/gradstudies/new-students/important-first-steps

Students may also write to:

National Council of State Boards of Nursing
111 East Wacker Dr.
Suite 2900
Chicago, IL 60601-4277
Telephone: 312.525.3600

Once admitted to FPB, an application form for a student visa will be sent to the student. Upon enrollment at the university, the student must subscribe to the Student Medical Insurance Plan or have proof of other medical insurance coverage.

Nursing Centers of Excellence

Unparalleled Opportunities

The Centers of Excellence at the Frances Payne Bolton School of Nursing expose students first-hand to nursing research, global health care systems, evidence-based practice, initiatives in aging care, self-management, end-of-life science, inclusion of persons with disabilities into research, and flight nursing.

PAHO/WHO Collaborating Center for Research and Clinical Training in Home Care Nursing (PAHO//WHOCC) (https://nursing.case.edu/research/centers/paho-who)

The PAHO/WHOCC is affiliated with the Pan American Health Organization and World Health Organization, which was established in 1948 by the United Nations as its specialized agency for health. The PAHO/WHO’s objective, as set out in its Constitution, is the attainment by all peoples of the highest possible level of health. PAHO/WHO Collaborating Centers are designated by the PAHO/WHO to collect and disseminate information on world health issues, provide education and training, and participate in collaborative research. The PAHO/WHO Collaborating Center at FPB is charged with research and clinical training in home care nursing and is one of only 9 designated centers for nursing in the United States.

Sarah Cole Hirsh Institute for Best Nursing Practices Based on Evidence (https://nursing.case.edu/hirsh)

The Sarah Cole Hirsh Institute for Evidence Based Practice is an endowed research and training institute to promote implementation of evidence into clinical practice. Established in 1998 with the generous endowment by Sarah Cole Hirsh (https://nursing.case.edu/hirsh/about), the center focuses on annual training and research in EBP for graduate students, leaders, and current clinicians. In close collaboration with the Quality Safety Education for Nurses Institute, the center’s key objective is to increase implementation of EBP guidelines and promote quality, safety and reduce cost in care.

The University Center on Aging and Health (UCAH) (https://nursing.case.edu/ucah)

By the year 2040, a staggering number (approximately 21.7%) of the US population will be persons 65 years of age and older. Elder care is projected to be the fastest growing employment sector within the health care industry. UCAH at Case Western Reserve University serves international, national, and local communities by providing an interdisciplinary platform for gerontological education, research, and services. A key objective of UCAH is to increase the number of students studying gerontology; and utilize its partnerships to promote interdisciplinary collaboration in research and education.

Center of Excellence for Self-Management Advancement through Research and Translation (SMART) (https://nursing.case.edu/research/centers/smart)

The SMART Center is a National Institute of Nursing Research/National Institute of Health-funded Center of Excellence to build the Science of Self-Management. The SMART center engages in interdisciplinary collaboration and partnerships to develop and support programs of research regarding self-management of health and illnesses. A recent focus of the SMART Center is to expand knowledge related to the brain-behavior connections associated with self-management. Its goals are to expand knowledge related to self-management through interdisciplinary investigations of self-management, expand the number of research projects aimed at improving our scientific understanding of the brain-behavior connections specific to self-management of health and illness, increase the number of investigators conducting research targeted at the brain-behavior connections specific to self-management of health and illness, and to serve as a national leader in research and dissemination of research findings to the scientific communities.

Full Inclusion of Persons with Disabilities in Self-Management Research (FIND) Lab (https://nursing.case.edu/research/centers/find)

The FIND Lab’s mission is to promote the full inclusion of persons with disabilities in mainstream health care research through use of Universal Design of Research and to encourage research on the general health care needs of persons with disabilities. It is funded by the National Institutes of Nursing Research/National Institute of Health. Services are provided to researchers about the design and conduct of research so that persons with sight, hearing and mobility impairment can be included in mainstream research. Consultation regarding intervention design, recruitment, and data collection methods is provided.

The Dorothy Ebersbach Academic Center for Flight Nursing (https://nursing.case.edu/flight)

The Dorothy Ebersbach Academic Center for Flight Nursing, formerly the National Flight Nurse Academy, serves as part of the MSN program’s Adult-Gerontology Acute Care Nurse Practitioner Flight Nursing subspecialty. It is the first formal training program of its kind to prepare nurses at the advanced practice level to provide care to individuals outside of hospitals, but at a hospital level of care.

Quality and Safety Education for Nurses (QSEN) Institute (http://qsen.org)

The QSEN Institute is a comprehensive, competency based resource center for faculty and clinical nurse educators to empower nurses with knowledge, skills, & attitudes to improve quality & safety across healthcare systems (QSEN.org (http://qsen.org)). QSEN addresses the challenge of educating nurses with the knowledge, skills, and attitudes (KSA) necessary to continuously improve the quality and safety of the healthcare systems in which they work.
The QSEN Institute hosts a National Conference each year which is designed to attract innovators and nurture faculty and nursing leaders for the improvement of quality and safety education. The conferences highlights innovations in curricular design and teaching strategies that accomplish QSEN competency development. Research related to quality and safety education in pre-licensure, advanced practice programs and clinical practice is also shared. Learn all that QSEN has to offer here. (http://www.qsen.org)

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NUAN 450. Pharmacological Strategies in Anesthesia Practice. 1 Unit.
Application of pharmaco-kinetic and pharmaco-dynamic principles as they relate to specific anesthetic and adjunct drugs used in anesthesia practice. Integration of this information into clinical area regarding anesthetic uses, dosages, and side effects of these classes of drugs is emphasized. Coreq: NUAN 449.

NUAN 451. Physiological Variables and Responses I: Respiratory System. 1 Unit.
A detailed study of the anatomic structures and related physiochemical mechanisms governing respiratory function in health and disease. Assess the functional integrity of this system utilizing all pertinent objective and subjective data. Consider the impact of anesthetic agents and techniques on this system and how one can plan an anesthetic to facilitate health-seeking behaviors as a patient attempts to attain, maintain or regain optimal health. The effects of anesthesia, implications and for all types of surgery, and the impact on the respiratory system will be discussed. Prereq: NUAN 459 and NURS 453.

NUAN 452. Physiological Variables and Responses: The Cardiovascular System. 1 Unit.
A detailed study of the anatomic structures and related physiochemical mechanisms governing cardiovascular function in health and disease. Assess the functional integrity of this system utilizing all pertinent objective and subjective data. Consider the impact of anesthetic agents and techniques on this system and how one can plan anesthetic to facilitate health-seeking behaviors as patients attempt to attain, maintain, or regain optimal health. Implications for all types of surgery in view of effect of anesthesia on cardiovascular system, however, special attention on surgery involving this specific system. Coreq: NUAN 459 and NURS 453.

NUAN 453. Physiological Variables and Responses III: Peds, OB, Endo & Geriatrics. 1 - 5 Units.
Study of health-seeking behaviors and intervening variables with special consideration of the anatomy, physiology, and pathophysiology of the pediatric and obstetric, endocrine and geriatric patient. Focus will be on the integration of this information into the nurse anesthesia care to support the health-seeking behaviors of these patients. Prereq: NUAN 451 and NUAN 452.

NUAN 454. Physiological Variables and Responses IV: Renal and Neurologic Systems. 3 Units.
Systematic investigation of the physiologic factors related to health-seeking behaviors with special emphasis on pathophysiology of the renal and neurological systems. Focus will be on the integration of this knowledge into the planning, implementation, and evaluation of patients requiring nurse anesthesia intervention. Prereq: NUAN 453.

NUAN 455. Anesthesia Nursing I. 1 Unit.
An introduction to the art and science of nurse anesthesia including basic anesthetic principles and beginning clinical practicum to introduce the student to anesthetic equipment and operating room environment. This course is designed to give the student practical information regarding administration of safe anesthesia.

NUAN 456. Anesthesia Nursing I. 1 Unit.
Progressive, guided instruction on the clinical and ethical management of clients undergoing all forms of anesthesia. This course is designed to prepare the nurse in the administration of a safe, routine anesthetic with a moderate amount of instructor intervention. Prereq: NUAN 458 and NUAN 459.

NUAN 457. Anesthesia Nursing III. 1 Unit.
Graduated, guided instruction in clinical management of clients receiving various types of anesthesia. Focus is on the preparation and planning for anesthesia utilizing Schlotfeldt paradigm. Includes actual administration of anesthesia for clients exhibiting more complicated pathophysiology. More advanced technical instruction and experience. Correlation of didactic and clinical materials, as well as continuous evaluation of student progress are integral to this course. Prereq: NUAN 456.
NUAN 458. Principles of Anesthesia I. 2 Units.
An introduction to the art and science of nurse anesthesia, including basic anesthetic principles, chemical and physical properties of anesthesia, and basic Anesthetic pharmacology. This course is designed to introduce students to basic anesthesia safety, Anesthesia practice, and the operating room environment. Coreq: NURS 459.

NUAN 459. Principles of Anesthesia II. 2 Units.
In-depth study of principles of regional anesthesia and pain management. Emphasis is placed on relevant anatomy and physiology, preoperative assessment and appropriate patient selection, appropriate use of equipment, pharmacology of commonly used medications, techniques for administration, and physiologic alterations/complications. Prereq: NUAN 458.

NUAN 460. Advanced Principles of Anesthesia 1. 3 Units.
An in-depth exploration of the anatomy, physiology, and pathophysiology of the cardiovascular, respiratory, and hematologic systems in the context of anesthesia care. Implications of cardiovascular, respiratory, and hematologic disease for all types of surgery are explored, with emphasis on anesthetic management of surgical procedures related to these systems. Prereq: NUAN 459.

NUAN 461. Advanced Principles of Anesthesia 2. 2 Units.
An in-depth exploration of the anatomy, physiology, and pathophysiology of the renal, endocrine, and neurologic systems in the context of anesthesia care. Implications of renal, endocrine, and neurologic disease for all types of surgery are explored, with emphasis on anesthetic management of surgical procedures related to these systems. Prereq: NUAN 460.

NUAN 462. Advanced Principles of Anesthesia 3. 3 Units.
An in-depth exploration of the anatomy, physiology, and pathophysiology of pediatric, obstetric, and geriatric patients within the context of anesthesia care. Implications of physiologic changes across the lifespan are explored, with emphasis on the anesthetic management of anesthetic and surgical procedures related to these patient populations. Prereq: NUAN 461.

NUAN 458A. Nurse Anesthesia: Advanced Practice IA. 2 Units.
Individual, in-depth study of advanced clinical nurse anesthesia in such specialty areas as neurosurgical, cardiovascular, obstetric and pediatric anesthesia. The nurse learns to handle more difficult, specialized patients who are at a higher risk. Emphasis is on more complex management with advanced monitoring techniques, use of pharmacological agents and handling higher stress situations. Students develop and utilize practical clinical applications of nurse anesthesia theory. Students are individually assigned to specialty areas and are formally evaluated at the end of each rotation. Prereq: NUAN 462.

NUAN 458B. Nurse Anesthesia: Advanced Practice IB. 1 Unit.
Individual, in-depth study of advanced clinical nurse anesthesia in such specialty areas as neurosurgical, cardiovascular, obstetric and pediatric anesthesia. The nurse learns to handle more difficult, specialized patients who are at a higher risk. Emphasis is on more complex management with advanced monitoring techniques, use of pharmacological agents and handling higher stress situations. Students develop and utilize practical clinical applications of nurse anesthesia theory. Students are individually assigned to specialty areas and are formally evaluated at the end of each rotation. Case presentations and group discussion designed to assist the student in conceptualizing, analyzing and evaluating various nurse anesthesia strategies as they relate to the client’s health seeking behaviors and goals are also emphasized. Prereq: NUAN 458A.

NUAN 552. Nurse Anesthesia: Advanced Practice II. 1 - 5 Units.
The continuation of advanced, independent clinical nurse anesthesia administration. Emphasis is on management of higher risk patients for more difficult procedures, performing total anesthetic care with minimum of anesthesiologist supervision, and readiness for transition from student to graduate status. Prereq: NUAN 551A and NUAN 551B and NUAN 551C.

NUED Courses

NUED 402. Common and Acute Health Problems of Children for Nursing Education. 3 Units.
This course introduces the common and acute health problems occurring in infancy through adolescence using a bio/psycho/social/cultural approach. Pathophysiology, assessment and teaching strategies specific to acute and common problems in children will be emphasized. Education strategies used to enhance, maintain and restore health will be discussed. Prereq: NUNP 401.

NUED 403. Management of Complex Chronic Problems in Children for Nursing Education. 3 Units.
This course focuses on the primary and rehabilitative health care concepts specific to the management of complex, multi-dimensional health problems experienced by infants, children and adolescents within the context of their family and community environments. Emphasis will be placed on the educational approaches to promote interprofessional communication. Prereq: NUED 402.

NUED 419. Family Health Nursing: Health of Adults and Older Adults. 3 Units.
This course introduces the student to the practice of primary health care of adults and older adults. The course includes principles of growth and development, health promotion, disease prevention and management of common acute and chronic health problems. Emphasis is placed on the biological, psychological, social and cultural aspects of care. Pathophysiology, assessment and diagnostic techniques specific to the acute and common problems are stressed. Nursing strategies related to health problems used to enhance, maintain, and restore health are emphasized. Health seeking behaviors and the impact of the family on the adult and older adult are stressed. Prereq: NURS 459. Coreq: NURS 430.

NUED 431. Advanced Oncology Nursing. 2 Units.
The emphasis of this course is on the genetic basis and pathophysiology of cancer, and common treatment modalities. Advanced practice nursing responsibilities in all phases of cancer care (prevention, detection, diagnosis, treatment, survivorship, and end of life) will be discussed. Traditional, experimental, and complementary treatment modalities will be explored in relation to mechanisms of action, efficacy, and short and long-term side effects. Strategies for addressing health promotion and problem management in promoting quality of life for patients with cancer will be critically evaluated. Prereq: NUED 419.

NUED 432. Common & Acute Health Problems of the Adult and Older Adult. 3 Units.
This course introduces the common and acute health problems occurring across the adult life span. A problem-oriented approach is used with emphasis on the biological, psychological, social, and cultural aspects of care. Pathophysiology, pharmacology, assessment, and diagnostic strategies specific to the acute and common problems of adults and older adults will be included. Nursing strategies used to enhance, maintain, and restore health will be emphasized. Prereq: NURS 459 and NUNP 410. Coreq: NURS 430.
NUED 434. Advanced Management in Adult and Older Adult Primary Care. 3 Units.
This course focuses on the health care concepts specific to the management of complex multidimensional health problems experienced by adults, older adults within the context of their family and community environments. Pathophysiology, assessment, and diagnostic strategies specific to complex health problems are emphasized. The selection of management strategies used to enhance outcomes will be stressed. Prereq: NUED 449.

NUED 438. Foundations in Acute Care Nursing of Adults and Older Adults for Nursing Education. 3 Units.
The course focuses on establishing elements of acute care and critical care nursing practice assessment and diagnostic reasoning across the continuum of healthcare services. Content is designed to develop application of specialized physiologic and psychological knowledge to meet needs of adults and older adults with complex acute and/or chronic health conditions as a basis for teaching acute and critical care nursing. Advanced pathophysiology is strongly recommended. Prereq: NURS 459.

NUED 443. Acute Health Problems of Adults and Older Adults. 4 Units.
Emphasis in this second of sequenced Adult-Gerontology Acute Care Nursing education courses is on the pathophysiology, assessment, and diagnostic approaches to adults and older adults with complex acute and chronic health disorders that manifest with physiologic instability. The content focuses on further development of diagnostic reasoning, clinical judgment, caring practices, and collaboration in healthcare systems that deliver acute and critical care nursing.

NUED 444. Management of Acutely Ill Adults and Older Adults for Nursing Education. 2 Units.
This course focuses on concepts specific to complex, multi-dimensional health problems of acute and critically ill adults and older adults. Content focuses on management of patients with complex health problems and life-threatening conditions across the entire adult spectrum. Prereq: NUED 443.

NUED 449. Primary Care of the Older Adult. 3 Units.
This course will focus on the assessment of the older adult’s nutritional needs, functional status, mental status (cognitive and affective), social support systems, and caregiver stress. These factors are analyzed in various environments, such as acute care, ambulatory care, home care, day care, long-term care, and rehabilitation. Epidemiological and health behavior models are used to assess health risks, assist with problem identification, primary, secondary, and tertiary prevention strategies. Cultural, ethnic, and developmental issues are addressed. Concepts, assessment strategies, interventions and evaluation approaches specific for older adults are identified. Prereq: NUED 432.

NUED 454. Well Woman Health Care. 2 Units.
The focus of this course is the application of theory, practice and research for promotion of health and wellness in the assessment and management of common gynecologic and family planning issues encountered by a diverse population of women in ambulatory settings. Emphasis is on promotion of health behaviors, identification and management of deviations from normal, anticipation of problems and the importance of consultations, referrals and collaborative management. Culturally appropriate interventions are integrated throughout. Prereq: NURS 459.

NUED 455. The Childbearing Family. 2 Units.
The focus of this course is the application of theory, practice and research in promotion of health and wellness of childbearing women using a family-centered approach. Emphasis is on normal aspects of pregnancy, promotion of health behaviors, identification and management of deviations from normal, anticipation of problems and the importance of consultations, referrals and collaborative management. Prereq: NUED 454. Coreq: NURS 430.

NUED 509. Curriculum and Instruction. 3 Units.
The purpose of this course is to explore the theoretical underpinnings of education and to examine innovative approaches to critical thinking. Students are provided the opportunity to analyze philosophies and principles of education along with teaching and learning styles. The focus of this course is on curriculum planning and development congruent with the philosophy and objectives of a nursing program. Curriculum development includes determination of program and course objectives, along with selection and organization of appropriate learning experiences to meet these objectives. Techniques for instruction in the classroom, laboratory, and clinical settings are explored.

NUED 559. Primary Care in Women's Health. 2 Units.
In this course, students gain knowledge needed to assess and manage primary health care problems commonly encountered by diverse populations of women in ambulatory settings. This course prepares the student to use the problem solving approach to assist individuals with common acute and chronic health problems. Culturally appropriate health promotion and disease prevention are integrated throughout. Students are introduced to the dynamics of the managed care environment. Prereq: NUED 455.

NUMN Courses
NUMN 400. Guided Study. 1 - 6 Units.
Selected topics in basic nursing. May include clinical experiences.

NUMN 401. Introduction to the Discipline and Practice of Nursing. 6.5 Units.
This course is an introduction to the discipline and practice of nursing. Factors influencing health and illness will be explored. Selected nursing strategies and interventions designed to support the maximum health potential of the adult client will be incorporated into lab sessions and practiced in acute care and other settings as arranged. Historical, societal, and legal influences on nursing and the role and functions of the professional nurse will be examined. Coreq: NUMN 402 and NUMN 410.

NUMN 402. Pharmacology for the Advanced Generalist Nurse. 3 Units.
This course is an introduction to the principles of pharmacology and pharmacotherapeutics, including characteristics of the major drug classifications with emphasis on drug action and adverse effects. Students will apply knowledge of pharmacology to implications for safe, patient-centered nursing care. Coreq: NUMN 401 and NUMN 410.
NUMN 403. Introduction to Nursing Informatics. 1 Unit.
This course will introduce students to the concepts of health informatics and the role nurses play in the management of information within the health care setting. Foundational knowledge that supports clinical practice, education, research, and administration will be studied as well as core models and theories of nursing informatics. Students will develop an awareness of the importance of nursing involvement in the design, implementation, and use of information systems and other technologies. Coreq: NUMN 401.

NUMN 405. Pathophysiology for the Advanced Generalist Nurse. 3 Units.
This course in clinical pathophysiology examines the biological basis and pathophysiological outcomes of selected disease processes that alter human physiologic and cognitive function. Students will relate the pathogenesis of selected disease conditions and pathologic states to their risk factors, symptomatology, and prevention. Prereq or Coreq: NUMN 401.

NUMN 406. Nursing Care of Older Adults in Health and Illness. 2.5 Units.
This course will explore the concept of aging in health and illness with an emphasis on the older adult as an individual with the capacity to grow and develop. Theories of aging, geriatric syndromes, and the multiple interacting determinants influencing the health of older adults will be examined. Students will design and implement theory and evidence-based, safe, patient-centered nursing interventions tailored to the unique needs of older adults. Prereq or Coreq: NUMN 401 and NUMN 410.

NUMN 407. Acute Care Nursing of the Adult. 8.5 Units.
The focus of this course is the integration of the nursing process in clinical practice. Human responses to significant health events and alterations are analyzed. Application of relevant physiology, psychosocial dimensions, and pharmacology are included. Particular emphasis is placed on nursing strategies, interventions, and the evaluation of their effectiveness in the care of the acutely ill adult. Prereq or Coreq: NUMN 401 and NUMN 410.

NUMN 409. Advanced Generalist: Health Policy, Advocacy, and Economics. 1.5 Unit.
This course is designed to address professional role development of the advanced generalist nurse. In this course, students will examine economics, health policy, and advocacy and the role of the advanced generalist nurse as political activist and policy advocate within the U.S. health care delivery systems of care. Policies that influence health care economics, safety, and quality will be investigated. Prereq: NUMN 401.

NUMN 410. Health Assessment for the Advanced Generalist Nurse. 2.5 Units.
This course uses a comprehensive, system-by-system, patient-centered approach to provide students with assessment and interviewing skills required for practice as an advanced generalist nurse. Students will apply critical thinking to make decisions regarding utilization of assessment findings including communication of the findings to the patient. Coreq: NUMN 401.

NUMN 411. Introduction to Public Health Nursing. 3 Units.
This course introduces the student to the principles and practice of public health nursing. An ecological perspective of the determinants of health will be used to examine the influence of society and communities on the health of individuals and groups. Culturally-relevant, asset-based strategies will be used to plan and implement public health nursing interventions. Coreq: NUMN 401.

NUMN 413. Issues and Ethics in Health Care. 2 Units.
This course introduces students to the principles underlying ethical issues and methods of rational decision making. Fundamental theories will be reviewed and applied through case analyses to address ethical dilemmas common to modern health care.

NUMN 414. Concepts in Nursing Management. 2.5 Units.
This course focuses on the study of basic concepts related to management in nursing and working with multidisciplinary teams in the provision and coordination of care. Concepts of nursing management including; planning, organizing, staffing, delegating, and budgeting within healthcare settings will be discussed. Coreq: NUMN 407.

NUMN 415. Parents and Neonates in Health and Illness. 4.25 Units.
This course introduces biological, psychosocial, and developmental concepts applicable to the nursing care of women, newborns, and families during the childbearing cycle. Emphasis is placed on assessment and identification of health needs as parents and neonates respond to the changes inherent in the childbearing cycle. Strategies related to nursing care of parents and neonates are discussed. The clinical experience focuses on the direct application of these concepts and strategies in the care of patients in various perinatal settings. Prereq: NUMN 407. Coreq: NUMN 414.

NUMN 416. Children and Families in Health and Illness. 4.25 Units.
This course is the study of children from infancy through adolescence and their health status from a developmental perspective. Emphasis is on healthy children as well as those with common acute and chronic illness within the context of their family environment. Nursing strategies focus on interventions to promote, restore, and maintain health and foster growth and development. These strategies are based on understanding advanced concepts of children's and families' responses in health and illness. Prereq: NUMN 407. Coreq: NUMN 414.

NUMN 417. Psychiatric Mental Health Nursing. 4 Units.
This course is designed to address psychiatric nursing concepts related to mental illness and addiction. The focus is on achieving optimal health for clients with acute and chronic psychiatric disorders using interpersonal techniques and applying the nursing process. Nursing strategies that are appropriate for assessment and intervention with individuals, families, and groups to facilitate optimal mental health and recovery will be discussed and evaluated. Prereq: NUMN 407.

NUMN 418. Intro to Critical Care Nursing. 7 Units.
The focus of this course is on integrating the knowledge and skills required to safely and effectively provide quality patient care in the critical care setting. Emphasis is placed on implementation of the nursing process and standards of practice required to care for critically ill patients and their families. The didactic component includes topics on current practice and trends in critical care nursing. The clinical component provides students with opportunities to implement the roles and functions of the advanced generalist nurse. Prereq or Coreq: NURS 502.

NUMN 419. Advanced Generalist Leadership Practicum. 2 Units.
This course is part of the concentration in leadership for safe quality healthcare. It provides students with clinical practice opportunities to synthesize knowledge, skills, and attitudes, and implement the roles of the advanced generalist nurse as leader for evidence-based quality healthcare for populations across the continuum of care. Coreq: NURS 451, NURS 502, and NUMN 409.
NUND Courses

NUND 401. Introduction to the Discipline and Practice of Nursing. 7.5 Units.
This course is an introduction to the discipline and practice of nursing. Factors influencing health and illness will be explored. Selected nursing strategies and interventions designed to support the maximum health potential of the adult client will be incorporated into lab sessions and practiced in a variety of settings. Small group seminars will be used to examine historical, societal, and legal influences on nursing and the role of functions of the professional nurse. Coreq: NUND 402 and NUND 410.

NUND 402. Introduction to Pharmacology. 3 Units.
This course introduces basic principles of pharmacology and pharmacotherapeutics. A survey of characteristics and uses of major drug groups with an emphasis on nursing implications is presented. Coreq: NUND 401 and NUND 410.

NUND 403A. Introduction to Nursing Informatics. 1 Unit.
This course will introduce students to the concept of health informatics and the role nurses play in the management of information in supporting all areas of nursing including clinical practice, education, research, and administration. Using case studies, lecture and class discussion. Students will develop an awareness of the importance of nursing involvement in the design, implementation, and use of information systems and other technologies. Coreq: NUND 401.

NUND 403B. Nursing and Health Informatics. 1 Unit.
This is the second of a two part course sequence in Nursing Informatics. The focus of this course is the transdisciplinary nature of informatics in health care and the use of advanced information technologies (IT) to support decision-making, promote safety, and ensure quality in patient care. Current issues in health care policy and legislation relating to health information technology will be discussed. Prereq: NUND 403A.

NUND 404A. Inquiry A for the Graduate Entry DNP. 2 Units.
This course provides an introduction to conceptual and theoretical thinking. Students will examine knowledge development in nursing, conceptual structures, and the use of theory in nursing practice and research. Coreq: NUND 401.

NUND 404B. Inquiry B for the Graduate Entry DNP. 2 Units.
This course is a continuation of NUND 404A GE Inquiry A. It completes the introduction to conceptual and theoretical thinking and begins examination of the research process in nursing. The student will examine scientific inquiry and scientific investigation, including the research process. Prereq: NUND 404A.

NUND 404C. Inquiry C for the Graduate Entry DNP. 2 Units.
This course is a continuation of NUND 404B GE DNP Inquiry B. It expands the examination of scientific investigation in nursing and includes data management, analysis, and interpretation; critique of existing research; and implications for nursing practice. Coreq: NUND 404B.

NUND 408. Introduction to Concepts of Genetics in Nursing. 1 Unit.
Introduction to the theories and concepts relevant to human genetics and genomics and their applications in health care. Coreq: NUND 407.

NUND 409A. Professional Role Development: Leadership. 1 Unit.
This seminar is the second in a series designed to address professional role development. The seminar focuses specifically on leadership development in nursing. Prereq: NUND 407.

NUND 410. Health Assessment. 2.5 Units.
Comprehensive introduction to the assessment skills required for a successful nursing practice. Basic skills, such as vital signs, are taught along with a system by system approach to physical examination. Taking a health and psychosocial history is integrated into the course. The course is taught concurrently with anatomy and physiology, concepts of nursing practice, and strategies and interventions for alterations in functioning. Coreq: NUND 401 and NUND 402.

NUND 411A. Public Health Nursing A. 2.5 Units.
This is the first of a two course sequence in public health nursing - health promotion-disease prevention for groups, populations, and communities. This course will focus on enhancing the health and health-seeking behaviors of groups and populations. Adult teaching-learning theories and processes will be explored. Coreq: NUND 407.

NUND 411B. Public Health Nursing B. 2 Units.
This is the second of a two course sequence in public health nursing - health promotion-disease prevention for groups, populations, and communities. This course will focus on enhancing the health and health-seeking behaviors of a selected community Coreq: NUND 411A.

NUND 450. Applied Statistics. 3 Units.
This course provides an advanced overview of the assumptions and applications necessary to analyze and interpret questions and research related to clinical practice. Emphasis will be on statistical interpretation of research. During the course, data management, statistical analysis, and data interpretation, as well as univariate, bivariate, and multivariate statistics such as ANOVA and ANCOVA will be examined. The data analysis process will be examined and deconstructed throughout the course. Prereq: STAT 201 or equivalent within past 5 years.

NUND 500. D.N.P. Thesis. 1 - 6 Units.
Systematic investigation of a clinically based research problem selected by the student for independent study. This includes proposal refinement and acceptance, data analysis and thesis completion under thesis committee supervision. Prereq: NURS 521.

NUND 504. Theories for Nursing Practice and Scholarship. 3 Units.
This initial course in the Doctor of Nursing Practice program examines the nature of theory, theory development in nursing, and significant conceptualizations of nursing. Application of mid-range theory to practice, practice change, and scholarship is explored. Recommended preparation: Post Masters graduate standing or permission of faculty.

NUND 505. D.N.P. Project. 1 - 6 Units.
Systematic completion of a project based on existing educational or clinical research. The project could include: (1) program needs assessment, (2) development and testing of an assessment instrument/protocol for clients, (3) implementation and evaluation of a new program; or evaluation of a major existing program. The evaluation may include financial, clinical, or educational components as appropriate to the project. The project will be developed under the supervision of the student’s N.D. project committee. Prereq: NURS 521.

NUND 506. Leadership in Organizations and Systems. 3 Units.
This course introduces the student to organizational design and leadership. The focus is developing skills to effectively lead individuals and teams toward maximizing organizational effectiveness. Elements of this course will include: organization culture, systems, communication, innovation and change.
NUND 507. Management in Advanced Nursing Practice. 3 Units.
This course is focused on management entrepreneurial concepts and issues related to advanced nursing practice. Seminars will focus on integrating legal, fiscal, quality improvement, and other intervening variables that affect environments of care. Prereq: NUND 506.

NUND 508. Health Care Policy and Planning. 3 Units.
The primary focus of this course is to explore the leadership role of nurses in health policy development and implementation as well as the role of research in health care policy formation and planning. Special emphasis is placed on selected national and international health policy issues that form the socio-political and economic context of nursing care and practice. Ethical dimensions of public policy formulations and implementation are highlighted. Offered as NUND 508 and NURS 609.

NUND 509. Curriculum and Instruction. 3 Units.
The purpose of this course is to explore the theoretical underpinnings of education and to examine innovative approaches to critical thinking. Students are provided the opportunity to analyze philosophies and principles of education along with teaching and learning styles. The focus of this course is on curriculum planning and development congruent with the philosophy and objectives of a nursing program. Curriculum development includes determination of program and course objectives, along with selection and organization of appropriate learning experiences to meet these objectives. Effective techniques for instruction in the classroom, laboratory, and clinical settings are explored.

NUND 510. Application of Health Information Technology and Systems. 1 Unit.
In this course, an overview of health information technology (HIT) is provided with focus on use of HIT in health care settings and among consumers. Course content includes use and evaluation of HIT by health care providers and patients.

NUND 530. Research Principles and Methods. 3 Units.
This course provides an overview of the components of the research process. Application of these principles to traditional as well as non-traditional research problems will be explored. Prereq: NUND 504.

NUND 531. Approaches to Practice Focused Research. 3 Units.
This course considers a variety of methods used for practice improvement and research. The applicability of these methods, such as action research, program evaluation and quality improvement, to the change process and to continuous improvement within various venues will be explored. The iterative, participative, and emergent nature of knowledge and practice innovations will be discussed. Prereq: NUND 530.

NUND 540. Practice Focused Inquiry I. 3 Units.
This course introduces the student to a variety of approaches that can be used for practice-focused inquiry. Applications of beginning elements of the scholarly process to practice-focused inquiry are reviewed. Elements include development of a problem statement and literature review. Prereq: NUND 504 and NUND 450.

NUND 541. Practice-Focused Inquiry II. 3 Units.
This course builds on Practice-Focused Inquiry I. The content expands student understanding of practice-focused methodology, including aims, a conceptual or theoretical framework, setting, sample, sources of data, measures and instruments. The student applies appropriate methodology to the development of a plan for their scholarly practice-focused project. Ethical issues and mechanisms for dissemination of the project results are included. Prereq: NUND 540.

NUND 507. Advanced Leadership and Management in Healthcare. 2 Units.
Leadership strategies and competencies for adapting to strategic advances in knowledge, technology, and organizational processes are explored. Emphasis is placed on developing strategic capacity within the dynamics of the competitive healthcare environment. Prereq: NUND 507.

NUND 609. Theoretical Foundations of Educational Testing and Evaluation. 2 Units.
In this course, an overview of educational measurement and evaluation is provided. Methods of evaluating teaching effectiveness, student learning, and student performance are explored. Prereq or Coreq: NUND 509.

NUND 610. Translating Evidence into Nursing Practice. 3 Units.
This course focuses on methods for developing best practice protocols, and translating them into practice. Prereq: NUND 504.

NUND 611. Practicum. 1 - 2 Units.
Under the guidance of the faculty advisor and designated mentor(s), the student will develop, implement and evaluate a specific clinical practice experience that strengthens and expands current expertise. This practicum will synthesize previous coursework. Prereq or Coreq: NUND 504.

NUND 615. Teaching Practicum. 1 - 6 Units.
In this preceptorship teaching practicum, the student may engage in classroom, laboratory, and clinical teaching assignments in nursing. The student will be expected to use current educational theory and nursing knowledge in completing the practicum experience (minimum 60 hours). Offered as NUND 615 and NURS 621. Prereq: NUND 509 and NUND 609.

NUND 619. Proposal Development. 1 - 2 Units.
Under guidance of the student’s chair, the student will develop a proposal addressing a practice-based research problem for acceptance by the proposal committee and IRB. Prereq: NUND 610.

NUND 620. Scholarly Project. 1 - 3 Units.
Under the guidance of their advisor and committee, the student will complete a systematic investigation of a previously identified problem. The experience will culminate with a written report of the findings. Prereq: NUND 619.

NUNP Courses

NUNP 401. Development and Health Promotion in Children and Adolescents. 3 Units.
This course examines the concepts of development and health promotion in children and adolescents. Concepts and theories from nursing and other related disciplines will be explored. These concepts are essential to the core knowledge utilized in the assessment and the provision of holistic health care to children and their families. Clinical application of theories and nursing strategies to optimize the health of children and their families are emphasized in the professional role development of students.

NUNP 402. Common and Acute Health Problems of Children. 6 Units.
This course introduces the common and acute health problems occurring in infancy through adolescence using a bio/psycho/social/cultural approach. Pathophysiology, assessment and diagnostic strategies specific to acute and common problems in children will be emphasized. Nursing strategies used to enhance, maintain and restore health will be discussed. Prereq: NURS 453, NURS 459 and NUNP 410. Prereq or Coreq: NURS 430.
NUNP 403. Advanced Management in Pediatric Primary Care. 5 Units.
This course focuses on the primary rehabilitative health care concepts specific to the management of complex, multidimensional health problems experienced by infants, children and adolescents within the context of their family and community environments. Pathophysiology, assessment and diagnostic strategies specific to complex health problems in children are emphasized. The selection of clinical interventions, clinical decision making and evaluation of strategies used to enhance the health outcomes of children and their families will be stressed. Emphasis will be placed on the consultation and referral processes within interdisciplinary and multidisciplinary teams. Prereq: NUNP 402.

NUNP 405. Neonatal Nurse Practitioner I. 3 Units.
This course introduces the role of the Neonatal Nurse Practitioner and concepts relevant to the management of the well or ill neonate. Analysis of nursing strategies to optimize health-seeking behaviors in families with well or ill neonates is highlighted. Prereq or Coreq: NUNP 416.

NUNP 410. Health Promotion Across the Life Span. 2 Units.
This course introduces diagnostic reasoning skills related to health promotion, disease prevention, and maintenance of function across the lifespan. Students develop skills that foster wellness in individuals, families, and communities. Epidemiological principles, risk appraisals, and other strategies are incorporated.

NUNP 412. Neonatal Nurse Practitioner II. 4 Units.
This course focuses on the health problems of the high-risk neonate in the context of family, culture, and community. Nursing strategies that enhance, maintain, and restore health in ill neonates and their families. Principles identified for advanced diagnostic and therapeutic approaches specific to the neonate, including pharmacology, are emphasized. Prereq: NUNP 405.

NUNP 413. Neonatal Nurse Practitioner III. 3 Units.
Pathophysiology, assessment, and diagnostic approaches specific to neonates with acute problems will be examined. Concepts related to discharge planning collaboration and long-term follow-up will be introduced. Prereq: NUNP 412.

NUNP 414. Neonatal Nurse Practitioner IV. 5 Units.
This course focuses on the acute and on-going rehabilitative care specific to the management of neonates with complex health problems. Pathophysiology, assessment, and diagnostic approaches specific to complex health problems of preterm infants, infants with chromosomal aberrations, and infants with multidimensional health problems will be emphasized within the context of their family and community environments. Community-based service learning will be stressed along with follow-up of the infant and family during the first year of life. Emphasis will be placed on consultation and referral processes within multidisciplinary teams. Prereq: NUNP 405, NUNP 412 and NUNP 413.

NUNP 416. Integrated Assessment of the Neonate. 3 Units.
This course introduces principles fundamental to the integrated assessment of the neonate. It stresses perinatal history taking, gestational age assessment, and physical assessment skills. The course provides the basis for problem identification, decision making, advanced therapeutics, and case management. Coreq: NUNP 405.

NUNP 419. Family Health Nursing: Health of Adults and Older Adults. 5 Units.
This course is an introduction to the practice of primary health care of adults and older adults. Principles of health promotion, disease prevention, management of common acute and chronic health problems and the impact of the family are incorporated. Emphasis is placed on the physical, psychological, social and cultural aspects of care. Pathophysiology, assessment and diagnostic techniques specific to the common acute and chronic health problems are integrated. Strategies related to health and illness care are used to enhance, maintain, and restore health. Collaboration with other health care professionals to enhance patient outcomes is explored. Prereq: NURS 453, NURS 459 and NUNP 410. Coreq: NURS 430.

NUNP 421. Symptom Management I. 1 Unit.
The emphasis of this course is on holistic care for persons and families, addressing symptoms that interfere with quality of life at all phases: during active-cure-oriented treatment of reversible illness, during life limiting illnesses, and at the end of life.

NUNP 422. Symptom Management II. 1 Unit.
The emphasis of this course includes the holistic care of persons and families, addressing symptoms that interfere with quality of life at all phases: during active-cure-oriented treatment of reversible illness, during active-cure-oriented treatment of reversible illness, during life limiting illnesses, and at the end of life. Contextual factors influencing care delivery will also be addressed. These include interdisciplinary collaborative practice models, financial, ethical, cultural, and legal considerations. The role of advanced practice nurse in promoting quality and safety in the provision of palliative care will be emphasized. Prereq: NUNP 421.

NUNP 429. Health Promotion & Common Reproductive Health Problems of Adolescents and Adults. 4 Units.
This course introduces the student to the care of the woman from puberty through menopause and her family. Physical and psychosocial health and deviations before, during, and after the childbearing years are assessed. The course content includes principles of education for childbearing, parenting, and fertility control. Strategies to optimize health-seeking behaviors are identified. Content on pregnancy and postpartum care is integrated into the course. Prereq: NURS 459.

NUNP 431. Advanced Oncology Nursing. 4 Units.
The emphasis of this course is on the genetic basis and pathophysiology of cancer, and common treatment modalities. Advanced practice nursing responsibilities in all phases of cancer care (prevention, detection, diagnosis, treatment, survivorship, and end of life) will be discussed. Traditional, experimental, and complementary treatment modalities will be explored in relation to mechanisms of action, efficacy, and short and long-term side effects. Strategies for addressing health promotion and problem management in promoting quality of life for patients with cancer will be critically evaluated. Prereq: NUNP 419.

NUNP 432. Common & Acute Health Problems of the Adult and Older Adult. 5 Units.
This course introduces the common and acute health problems occurring across the adult life span. A problem-oriented approach is used with emphasis on the biological, psychological, social, and cultural aspects of care. Pathophysiology, pharmacology, assessment, and diagnostic strategies specific to the acute and common problems of adults and older adults will be included. Nursing strategies used to enhance, maintain, and restore health will be emphasized. Prereq: NURS 453, NURS 459 and NUNP 410. Prereq or Coreq: NURS 430.
NUNP 434. Advanced Management in Adult and Older Adult Primary Care. 5 Units.
This course focuses on the health care concepts specific to the management of complex multidimensional health problems experienced by adults and older adults within the context of their family and community environments. Pathophysiology, assessment, and diagnostic strategies specific to complex health problems are emphasized. The selection of evaluation strategies used to enhance the outcomes will be stressed. Prereq: NUNP 449.

NUNP 438. Foundations for Adult-Gerontology Acute Care Nursing. 4 Units.
The course focuses on establishing elements of advanced nursing practice assessment and diagnostic reasoning across the continuum of healthcare services to meet the specialized physiologic and psychological needs of adults and older adults with complex acute and/ or chronic health conditions. Prereq or Coreq: NURS 453 and NURS 459 or students with an MSN and NP certification, permission of faculty.

NUNP 439. Family Health Nursing: Health of Children and Adolescents. 4 Units.
In this course students are introduced to the influence of family dynamics in the practice of primary health care of children and adolescents. The course includes the application of the principles of growth and development, disease prevention, health promotion, and management of common acute and chronic health problems in children and adolescents. Clinical application of strategies to optimize health seeking behaviors is emphasized. Collaboration with other health care professionals to enhance patient care is reinforced. Prereq: NUNP 429.

NUNP 441. Comprehensive Care of the Chronically Ill Adult and Older Adult. 4 Units.
The focus of this course is on implementation of advanced practice for patients with cancer and other life limiting conditions. Health promotion, health protection, disease prevention, and treatment of patients with cancer and other life-limiting conditions and their families will be included. An interdisciplinary approach to the care of patients and families across the cancer disease trajectory will be addressed. Cultural considerations for diverse populations will be incorporated in the implementation of advanced practice strategies.

NUNP 443. Acute Health Problems of Adults and Older Adults. 6 Units.
Emphasis in this second of sequenced Adult-Gerontology Acute Care Nursing clinical courses is on the pathophysiology, assessment, and diagnostic approaches to adults and older adults with complex acute and chronic health disorders that manifest with physiologic instability. The clinical practicum focuses on further development of diagnostic reasoning, clinical judgment, caring practices, and collaboration in health care systems that deliver acute and critical advanced practice nursing. Prereq or Coreq: NURS 430 and NUNP 438.

NUNP 444. Advanced Management of Acutely Ill Adults and Older Adults. 4 Units.
This third clinical course in the Adult-Gerontology Acute Care Nurse Practitioner sequence focuses on concepts specific to complex, multidimensional health problems of acute and critically ill adults and older adults. Clinical practice focuses on the management of patients with complex health problems and life-threatening conditions across the entire adult spectrum. Prereq: NUNP 443.

NUNP 449. Advanced Practice Nursing Care of the Older Adult. 4 Units.
This course integrates the principles of health promotion, disease prevention and rehabilitation in the care of older adults. The assessment of nutritional needs, functional status, mental status, social support systems, and caregiver stress will be addressed. These factors are analyzed in various environments, such as ambulatory care, home care, day care, long-term care, acute care, skilled nursing, and rehabilitation. Cultural, ethnic, and developmental issues are addressed. The diagnosis, treatment and management of acute and chronic conditions associated with aging but that can also occur in younger adults are presented. Description of interventions appropriate to restore or maintain an optimal level of function, or when appropriate, palliative or end of life care will be included. Prereq: NUNP 432.

NUNP 455. Management of Complex Acute Problems in Children I. 4 Units.
Application of knowledge, research findings, advanced skills and interventions, including pharmacotherapy; in the management of children with acute, chronic and critical conditions. Critical assessment strategies and management principals will be addressed. Coreq: NUNP 402.

NUNP 456. Management of Complex Acute Problems in Children II. 5 Units.
Integration of knowledge, research and advanced skills and interventions in acute care nursing with children with complex, acute, critical and chronic health conditions. Critical assessment strategies and management principals will be addressed including knowledge and skills with technological assessment modalities and procedures commonly associated with care of the acutely ill child. Interpretations, indications, contraindications, and complications will be addressed. Prereq: NUNP 455.

NUNP 464. Global Clinical Learning. 1 Unit.
This course will allow the MSN student to engage in clinical work in low and middle income medically under resourced communities providing direct patient care under clinical supervision of MSN faculty. Students will prepare for the experience by gaining knowledge of the history and culture of the region, common diseases prevalent in the area and orientation to the site operations. The student will focus on the 1) steps to diagnose, treat and implement a plan of care for area specific diseases; 2) culturally and resource appropriate treatments; 3) dental hygiene and nutrition as they impact the health of the local population. Students will prepare culturally appropriate presentations for local nurses and contribute to the preparation of non-medical members of the team for patient safety using current evidence based practices. Offered as NUNP 464 and NURS 464. Prereq: Enrollment in MSN, DNP or PhD in Nursing Program.

NURS Courses

NURS 110. Foundations of the Discipline. 1 Unit.
The course is designed to introduce the student to the practice, profession and discipline of nursing. A futurist perspective will provide a framework for discussion of the foundation of contemporary nursing practice within a variety of health care settings. Critical historical influences that affected the development of contemporary nursing will be discussed. Selected trends and issues that will guide future nursing practice will conclude this course.

NURS 111. Foundations of Practice. 3 Units.
This course is designed as a foundation for clinical nursing practice with a focus on communication, safety, and comfort. The relationship between theory, evidence, and nursing care will be explored. The basic components of the nursing process are presented as a framework for beginning clinical practice.
NURS 120. Nursing Informatics 1: Introduction. 2 Units.
This course focuses on the content, flow and processing of patient information and the role of the nurse as the communication gateway for that information. It provides an overview of the key players in the health care information systems environment and how these players impact the care process. The course is designed to build an understanding of basic information technologies and the ways in which a nurse can manage the information to support the delivery of client care.

NURS 122. Foundations of the Practice II. 3 Units.
This course builds on the concepts essential to the foundations of nursing practice presented in previous nursing courses. It is designed to focus on strategies, skills, and techniques to obtain a comprehensive individual health history, family health history, and physical examination. Therapeutic interventions based on assessment and scientific knowledge will be performed. BIOL 114, BIOL 116, NURS 110, NURS 111, all with grades of C or better.

NURS 160. Health Care in the Community. 1 Unit.
This course is a seminar focused on the delivery of culturally appropriate, community-based health care and on selected issues contributing to the growing disparities in health care outcomes. Students will engage in a field experience in a Cleveland community health facility or school system. The seminar will include sessions devoted to reflection and evaluation of the field experience related to issues contributing to disparities in health care and content related to public health nursing.

NURS 201. Applied Nutrition in Health and Disease. 2 Units.
This course builds upon the student’s knowledge of human physiology and metabolism. Nutrient requirements are highlighted as well as changes related to different stages in the lifespan. Contemporary nutritional issues will be addressed. Prereq: BIOL 114 and BIOL 116.

NURS 210. Teaching/Learning in the Community. 1 Unit.
This course expands on foundational public health nursing concepts to develop student knowledge, skills, and attitudes in providing culturally competent health care to diverse populations using the service learning model. This course explores the relationships between, learning needs, health literacy, teaching/learning interventions and evaluation of learning. Utilizing a balance between knowledge-centered and skill-centered approaches to delivering culturally competent care, students will engage in both traditional classroom and transcultural experiential learning encounters. Prereq: NURS 160.

NURS 211. Introduction to Pharmacology 1. 1.5 Unit.
This course is the first of two courses introducing the basic principles of pharmacology and pharmacotherapeutics, including review of characteristics and use of major drug classifications with emphasis on nursing implications. The pharmacological content presented in this course will be coordinated with Nursing Care of the Adult 1 with emphasis placed on patients experiencing co-morbid conditions. Prereq: BIOL 117, CHEM 119, NURS 122. Coreq: NURS 230 and NURS 250.

NURS 212. Introduction to Pharmacology 2. 1.5 Unit.
This course is the second of two courses introducing the basic principles of pharmacology and pharmacotherapeutics, including review of characteristics and use of major drug classifications with emphasis on nursing implications. The pharmacological content in this course will be coordinated with Nursing Care of the Adult 2 with emphasis focused on patients experiencing co-morbid conditions. Prereq: NURS 211, NURS 230 and NURS 250. Coreq: NURS 240 and NURS 317.

NURS 212. Introduction to Pharmacology 2. 1.5 Unit.
This course is the second of two courses introducing the basic principles of pharmacology and pharmacotherapeutics, including review of characteristics and use of major drug classifications with emphasis on nursing implications. The pharmacological content in this course will be coordinated with Nursing Care of the Adult 2 with emphasis focused on patients experiencing co-morbid conditions. Prereq: NURS 211, NURS 230 and NURS 250. Coreq: NURS 240 and NURS 317.

NURS 220. Nursing Care of the Adult 1. 5 Units.
This is the first of two courses focusing on the application of the nursing process to adults and older adults experiencing common acute and chronic health alterations. Special emphasis is placed on patient assessment, diagnostic testing, beginning medication teaching and administration, and other nursing interventions as they relate to caring for adults and older adults with alterations in fluid/electrolyte and acid/base balance, and respiratory, cardiac, genitourinary, and endocrine (diabetes) functioning. Care of the patient in the perioperative setting and care of the patient with cancer are also emphasized. Prereq: BIOL 117, CHEM 119, NURS 122. Coreq: NURS 211, NURS 250.

NURS 240. Nursing Care of the Adult 2. 4.75 Units.
This course builds upon the knowledge and skills mastered in NURS 230. Course content and learning opportunities provide students with the information necessary to collaborate with other members of the health care team in providing comprehensive care to adults and older adults. Students are expected to collaborate with members of the health care team to plan and implement interventions and to evaluate patient responses to selected interventions. Special emphasis is placed on patients experiencing co-morbid conditions which include alterations in immunologic, hemotologic, gastrointestinal, musculoskeletal, and neurologic functioning. Prereq: CHEM 121, NURS 211, and NURS 230. Coreq: NURS 212.

NURS 250. Aging in Health and Illness. 2 Units.
This course will explore the concept of aging as a healthy developmental process with a particular focus on older adults as active, independent and contributing members of the community. Content will include the process of healthy aging, major health problems for which older adults are at risk, and policy issues. Prereq: BIOL 117, CHEM 119, NURS 222. Coreq: NURS 211.

NURS 260. Evidence Based Public Policy in the Community. 1 Unit.
This course expands on foundational public health nursing concepts to develop student knowledge, skills, and attitudes in providing culturally competent health care to diverse populations using the service learning model. Utilizing a balance between knowledge centered and skill centered approaches students will apply concepts of team work and collaboration to experiential learning outcomes. Prereq: NURS 160.

NURS 277. BCLS and First Aid for Health Care Providers. 0 Unit.
Designed for healthcare professional students, this course follows the American Heart Association Basic Life Support (BLS) for Healthcare Providers Course objectives. It provides a variety of healthcare professional students the ability to recognize several life-threatening emergencies, provide CPR, use an AED, and relieve choking in a safe, timely and effective manner. Basic first aid skills are also included in this course.

NURS 310. Leadership in the Community. 1 Unit.
This public health course is designed to develop student knowledge, skills and attitudes in providing culturally competent health care to diverse populations, using the service learning model. Students will explore nursing’s role as a community health advocate in the promotion of health and the elimination of health disparities. Utilizing a balance between knowledge-centered and skill centered approaches to delivering culturally competent care, students will apply leadership concepts in both traditional classroom and transcultural experiential learning encounters. Prereq: NURS 210 and NURS 260.
NURS 315. Parents and Neonates in Health and Illness. 4.5 Units.
This course focuses on the study of child bearing families and their
health-seeking behaviors from a developmental perspective. Content
includes nursing knowledge and skills related to assessment of
health status of parents and neonates. Nursing strategies focusing on
interventions to promote, restore, and maintain health are discussed.
Prereq: NURS 212, NURS 240, NURS 317, NURS 342, and SOCI 203.

NURS 316. Infants, Children, and Adolescents in Health and Illness. 4.5
Units.
The study of infants, children, and adolescents, and the health-seeking
behaviors from a developmental perspective. Emphasis is on healthy
infants, children, and adolescents as well as infants, children, and
adolescents with common, acute, and chronic illness within the context
of their family environment. Nursing strategies focus on interventions
to promote, restore, and maintain health and foster growth and
development. Prereq: NURS 212, NURS 240, NURS 317, NURS 342, and
SOCI 203. Coreq: NURS 315.

NURS 317. Psychiatric-Mental Health Nursing. 3.75 Units.
The course is designed to address health-seeking behavior patterns
within the context of psychiatric and mental health nursing concepts.
The focus is on clients with psychiatric disorders and their mental health.
Nursing strategies that are appropriate for assessment and intervention
with individuals, families, and groups to facilitate optimal mental health
will be discussed and practiced. Prereq: NURS 211 and NURS 230. Coreq:
NURS 212.

NURS 320. Theoretical and Evidence Bases for Best Practice in Nursing.
3 Units.
This course explores the theoretical and evidence bases for best
practices in nursing. The course begins with an overview of the
theoretical and philosophical underpinnings of nursing practice and
nursing science. The course includes an intensive focus on the concept
evidence based practice and the process of evaluation supporting
practice. Additionally, the course introduces evaluation models used
to determine the effectiveness and quality of existing practice and to
recommend improvements. Counts as SAGES Departmental Seminar.
Prereq: STAT 201 or STAT 201R.

NURS 338. Care of the Adult and Older Adult with Complex Health
Alterations. 4.5 Units.
The purpose of this course is to provide the student with the knowledge
and skills to care for one or more complex, acutely ill adult patients,
who present with co-morbid conditions and may be dependent on
technologies. This complexity encompasses the physical, psychological,
social, spiritual, and ethical domains of care and includes both patient
and the family. Prereq: NURS 212, NURS 240, NURS 342 and NURS 317.
Coreq: NURS 339.

NURS 339. Care of the Perioperative Patient. 3.5 Units.
The purpose of this course is to provide the student with a dynamic
learning experience in a perioperative environment to enhance the
knowledge, cognitive and psychomotor skills to care for one or more
patients undergoing operative or invasive procedures. The Perioperative
Patient-Focused Model (AORN, 2008) will provide the framework for
this course. This Model addresses patient centered care, patient safety,
physiologic responses, and behavioral responses of the patient and
family. In addition, content will cover issues of quality and safety,
informatics, and identification of evidence based practice within the
perioperative context. The clinical setting is interdisciplinary and
multidisciplinary with other members of the perioperative team. As
a member of this team, the student will develop strategies to inspire
team work and collaboration with emphasis on communication, patient
advocacy and leadership skills. Prereq: NURS 212, NURS 240, NURS 317
and NURS 342. Coreq: NURS 338.

NURS 341. Concepts of Management and Leadership. 3 Units.
This course focuses on the study of basic concepts related to leadership
and management in the provision of nursing care. Highlighted units of
instruction include organizational culture and structure, leading high
performing teams, human and capital resource management, delegation
and outcome evaluation. The management functions of planning,
organizing, directing and evaluating are explored. Prereq: NURS 315,
NURS 316, NURS 338, NURS 339.

NURS 342. Medical Microbiology, Immunity, and Infectious Disease. 4
Units.
Introduction to viral, bacterial, rickettsial, fungal and parasitic organisms
pathogenic to humans, known to be the etiological agents of infectious
diseases. Review of the course, manifestations, pathogenesis,
edemiology and therapies of selected diseases associated with the
infectious disease intervening variable. Prereq: BIOL 117 and CHEM 121.

NURS 343. Issues and Ethics in Health Care. 2 Units.
This course is designed to introduce the student to the principles
underlying ethical issues and methods of rational decision making.
Fundamental theories will be reviewed and opportunity provided, using
case analysis, to apply the theories in addressing ethical dilemmas
common to modern health care. Prereq: NURS 315, NURS 316, NURS 338,
and NURS 339.

NURS 345. Nursing Informatics 2. 2 Units.
This course builds on information learned in NURS 120, and focuses
on the use of informatics in nursing practice, education, and research.
The emphasis is on using informatics to solve clinical problems. The
course addresses how nursing informatics has evolved as a discipline
and explores career options in nursing informatics. Current policy and
legislative influences on health care technology are also addressed.
Prereq: NURS 120.

NURS 352. Acute Care 3. 8 Units.
This course focuses on the knowledge and skills necessary to provide
nursing care for patients with complex problems. Emphasis is on nursing
strategies designed to provide comprehensive care to patients and their
families affected by acute illness. Clinical practice is directed toward
the care of acutely ill adults. Prereq: NURS 315, NURS 338, NURS 339,
NURS 373.
NURS 354. Nursing Care of Critically Ill Adults. 8 Units.
This course focuses on the integration of knowledge and skills to provide effective and efficient nursing care to critically ill adults. Emphasis is on nursing strategies directed toward the care of the critically ill patient with a focus on use of biomedical technology, planning and managing patient care, and beginning care of patients with complex care needs. Prereq: NURS 338, NURS 339, NURS 373.

NURS 356. Nursing Care of Critically Ill Neonates, Infants, and Children. 8 Units.
This course focuses on the knowledge and skills necessary for beginning practice in the nursing care of critically ill neonates, infants and children. Emphasis is on nursing strategies directed toward the application of basic principles of critical care nursing with attention to special needs of critically ill neonates, infants and children and their families. Prereq: NURS 316, NURS 338, NURS 339, and NURS 373.

NURS 360. Process Change in the Community. 1 Unit.
This public health nursing course is designed to develop student knowledge, skills, and attitudes in providing culturally competent health care to diverse populations, using the service learning model, by analyzing key community components that influence health and wellness. Students will explore nursing's role as a community health advocate in the promotion of health and the elimination of health disparities. Utilizing a balance between knowledge-centered and skill-centered approaches to delivering culturally competent care, students will engage in both traditional classroom and transcultural experiential learning encounters. Prereq: NURS 210 and NURS 260.

NURS 370. Information Technologies in Health. 1 Unit.
The focus of this course is the application of advanced information technologies in the health care of communities and populations. Building on a base of pre-requisite informatics course knowledge and student clinical experiences, the course will explore contemporary issues in informatics and the ways in which a nurse can manage the information to support the delivery of care to clients, communities, and populations. Prereq: NURS 345.

NURS 371. Public Health Nursing. 3 Units.
In this course, students will utilize a problem-based approach to develop knowledge and specific competencies in applying key concepts of public health, public health nursing and epidemiology. Through guided observation and classroom experiences, students will discover strategies to assess, plan, implement and evaluate population-focused programs for health promotion and disease prevention. Prereq: NURS 310 and NURS 360.

NURS 372. Health in the Global Community. 3 Units.
This course focuses on an analysis of the forces shaping community and global health patterns. Drawing on multidisciplinary sources, this course explores the impact of these global processes as they manifest in the health of our own and other societies. Emphasis is placed on analysis of the broad cultural, environmental, social-economic, and political systems that contribute to health status and outcomes, health policies, and health care delivery around the world. Prereq: NURS 310 and NURS 360.

NURS 373. Global Health Practicum. 5 Units.
The purpose of this practicum is to provide students with the opportunity to analyze the concepts of health and health care, health policy and finance, culture and ethics through a preceptored, community-based immersion experience in local, national or international settings. Students will apply epidemiological techniques, the skills of negotiation, partnership building, community assessment and nursing science in the identification and analysis of a health problem leading to the development of an intervention. Counts as SAGES Senior Capstone. Prereq: NURS 315, NURS 316, NURS 338, NURS 339. Coreq: NURS 371 and NURS 372.

NURS 394. Global Health Seminar. 3 Units.
The focus of this course is the issues and trends in global health from both a nursing and a trans-disciplinary perspective. The course covers how international social, political, economic, environmental, and cultural issues affect health and health care. Particular emphasis is placed on nursing's contribution to global health issues and outcomes. Offered as: NURS 394 and NURS 494.

NURS 399. Independent Study. 1 - 12 Units.
Independent guided study for undergraduate students with special needs or interests.

NURS 400. Guided Study in Nursing. 1 - 18 Units.
Independent study for students with special needs and interests.

NURS 404. Emergent Care of the Child. 2 Units.
This course provides an introduction to the care of the child requiring critical care transport. This course examines pathophysiology, assessment, diagnostic approaches, and interventions specific to emergent care of infants, children and adolescents by advanced practice nurses. Prereq: NURS 406.

NURS 405. Inquiry I - Theoretical Foundations. 2 Units.
This course provides an introduction to conceptual and theoretical thinking. Students will examine knowledge development in nursing, conceptual structures, and their uses as a basis for nursing practice and research.

NURS 406. Flight Nursing Seminar I. 1 Unit.
This seminar course provides a forum for preparing students to care for patients requiring air transfer to specialty care facilities. Special emphasis is placed on advanced procedures, flight physiology, and environmental influences on the clinical approach in order to apply acute care competencies to flight nursing practice. Prereq or Coreq: NUNP 443.

NURS 407. Critical Care Transport and Advanced Nursing Practice 2. 1 Unit.
This course provides continued application of advanced nursing practice management to individuals and groups of patients in the unstructured environments. Concepts specific to air medical environment, crew resource management, and critical care transport are further explored. Leadership and research for health care delivery in the air medical industry are introduced. Prereq: NURS 406.

NURS 409. Specialty Assessment and Diagnostics in Cardiovascular Nursing. 2 Units.
This course provides the basis for the selection and interpretation of assessment and testing strategies during the process of differential diagnosis of cardiovascular problems. Lecture is supplemented with specific clinical lab experiences.
NURS 410. Advanced Electrocardiography Seminar. 1 Unit.
This seminar focuses on advanced 12 lead ECG interpretation, cardiac rhythm abnormalities, and advanced nursing practice management when abnormalities in ECG waveforms and rhythms occur. Prereq: NURS 430 or Requisites Not Met permission.

NURS 411. Cardiovascular Nursing Seminar II. 1 Unit.
This seminar course focuses on the management of complex cardiovascular disease. Prereq: NURS 410.

NURS 412. Practice Change Implementation. 1 Unit.
The course focuses on evidence-based practice implementation and quality improvement methods to facilitate effective management of practice change. Students will define quality and safety problems in the healthcare system in which they work and then implement a change. The course covers issues related to evidence-based practice, teamwork, systems science, change management, and data analytics. Students will apply the concepts to practice through an implementation/quality improvement project.

NURS 416. Integrated Assessment of the Neonate for Midwives. 1 Unit.
This course introduces concepts fundamental to the integrated assessment of the neonate. Gestational age assessment and physical assessment skills are developed. The course provides the basis for problem identification, decision making, and case management.

NURS 421. Foundations of Palliative Care. 1 Unit.
This course is designed to provide health care professionals with knowledge about providing holistic care for clients of all ages and their families living with advanced illness. Palliative care as a discipline will be examined, with an emphasis on the interprofessional team in assisting patients and their families to make health care plans that reflect their goals and preferences.

NURS 422. Advanced Communication Strategies for Health Care Professionals. 1 Unit.
This course is designed to provide health care professional with theory, knowledge and skills important in establishing effective communication with clients, families and interprofessional team members when caring for clients living with advanced illness. Initiation of goal directed conversations, advance care planning and family meetings will be examined.

NURS 423. Palliative care in Specialized Populations. 1 Unit.
This course is designed for the health care professional to apply knowledge and skills in the provision of palliative care to selected populations. Current trends, ethical issues, and symptom management challenges are addressed. Prereq: NURS 421.

NURS 424. Advanced Symptom Management in Palliative Care. 1 Unit.
This course will enable health care professionals to gain knowledge and skills in providing advanced symptom management to patients and families experiencing complex illness. The management of selected distressing symptoms using evidence based strategies will be investigated. Prereq: NURS 421 and NURS 422.

NURS 425. Inquiry II - Research Process. 3 Units.
This course emphasizes scholarly inquiry, scientific integrity and scientific investigation. It includes study of the research process, particularly design, sampling, data collection and analysis, and interpretation and reporting of findings. Recommended preparation: NUND 201 or STAT 201. Prereq: NURS 405.

NURS 430. Pharmacology and Therapeutics. 3 Units.
This course focuses on the application of advanced pharmacology and pharmacotherapeutics for common conditions across the lifespan. Principles of pharmacokinetics, pharmacodynamics, and pharmacogenomics are applied. Pharmacotherapeutic decision points congruent with effective prescribing are emphasized, including integrating the ethical, legal and cost-benefits of pharmacological interventions. This course is designed to build on diagnostic reasoning and prior pharmacology study of actions and effects of drugs on the human system. RN licensure and practice recommended Prereq: Enrolled in MSN, DNP or PhD Nursing program.

NURS 431. Psychosocial and Spiritual Dimensions of Advanced Nursing Practice. 2 Units.
This course will focus on psychosocial and spiritual dimensions of care. Psychosocial aspects of care will address interviewing, counseling and coaching skills. In addition, skill in assessing depression, suicidal ideation and substance abuse issues will be addressed. The spiritual domain of health will be emphasized.

NURS 444A. Collaboration, Consultation, & Credentialing in Advanced Practice Nurs. 1 Unit.
The focus of this course is the process of consultation and collaboration in advanced practice nursing. The organizations that are involved in promoting and assisting advanced practice nurses (APNs) will be addressed. The similarities and differences in the roles of the APN will be explored. The process of credentialing APNs will also be examined.

NURS 444B. Role Development in Advanced Practice. 1 Unit.
The focus of this course is the study of the multiple roles integrated into advanced practice nursing including principles of management and leadership. Strategies to market the value of the advanced practice nurse (APN) role and the individual APN are addressed.

NURS 444C. Teaching and Learning in Advanced Practice. 1 Unit.
The focus of this course is the examination of the process of teaching, learning, and evaluation. A variety of teaching modalities applicable across the lifespan will be explored.

NURS 444A. Ethical and End of Life Issues in Advanced Nursing Practice. 1 Unit.
The focus of this course is ethical decision-making for advanced nursing practice. The interaction between the health care delivery system and ethical decision making is explored. The role of the nurse in identifying and addressing ethical dilemmas and applying communication strategies in assisting patients and families and the interdisciplinary team is emphasized.

NURS 444B. Health Care Delivery and Finance in Advanced Practice. 1 Unit.
The focus of this course is the study of the financial and business factors related to the health care delivery system and advanced practice nursing. Students will discuss strategies related to reimbursement, business practices, billing, and coding.

NURS 444C. Health Policy Legislation and Legal Issues in Advanced Practice. 1 Unit.
The focus of this course is the critical analysis of health policy and legal issues. Strategies for influencing the regulatory process will be explored.
NURS 451. Leadership for Quality Healthcare within Organizations and Systems. 3 Units.
This course prepares the student to take a leadership role within organizations and systems to improve the quality of health care. Theory-based strategies to promote change within organizations and systems will be examined. The influence of economic, legal, and political factors on health care will be considered. Current and emerging information technologies and communication patterns influencing outcomes of care will be explored.

NURS 453. Advanced Pathophysiology. 4 Units.
This course focuses on the biologic alterations produced by injury or disease among individuals across the lifespan. Physiologic and pathophysiologic concepts that contribute to an individual’s capacity for health and susceptibility to illness are examined. Prereq: Enrolled in Master of Science in Nursing Program.

NURS 454. Well Woman Health Care. 3 Units.
In this course, students learn to assess and manage common gynecologic and family planning issues encountered by a diverse population of women in ambulatory settings. Culturally appropriate interventions are integrated throughout. Supervised clinical experience focuses on achieving the foundation for beginning practice. This includes anticipating and identifying complications and participating in consultations, referrals and collaborative management. The application and synthesis of these principles, theories and concepts are emphasized in clinical pricum. Prereq or Coreq: NURS 453 and NURS 459.

NURS 455. The Childbearing Family. 4 Units.
The focus of this course is the application of theory, practice and research by advanced practice nurses in the promotion of health and wellness of childbearing women using a family-centered approach. Emphasis is on normal aspects of pregnancy, focusing on prevention of problems and promotion of health behaviors, as well as identification and management of deviations from normal. Supervised clinical experience includes understanding normal pregnancy, anticipating and identifying complications, participating in consultations, referrals and collaborative management. Prereq: NURS 454. Coreq: NURS 430.

NURS 457. Labor and Birth. 5 Units.
The art, theory, and science for nurse-midwifery practice is expanded through research, critical analysis of disseminated research, quality assurance, and other scholarly activities. The focus of this course is the application of theory, practice and research by advanced practice nurses in the promotion of health and wellness of women, newborns and their families during intrapartum and the immediate postpartum period. Emphasis is placed on the health-seeking behaviors of the mother and her family using a holistic approach which respects cultural, ethnic, and racial diversity in the provision and evaluation of care. Supervised clinical experience focuses on achieving the foundation for competent practice as a beginning practitioner. This includes anticipating and identifying complications and participating in consultations, referrals, and collaborative management. Prereq: NURS 455.

NURS 459. Advanced Health Assessment. 3 Units.
This course focuses on advanced assessment of individuals across the lifespan. This course incorporates communication skills, interpretation of data, and diagnostic reasoning. Prereq: Enrolled in Master of Science in Nursing Program.

NURS 460A. Theoretical Basis for Individual Counseling. 1 Unit.
This course emphasizes the ongoing development of the counseling relationship across the life span. The professional encounter between the individual and advanced practice nurse will be formulated based on the Helping Model for problem management. Students will differentiate counseling and therapy. Students will also develop and apply crisis intervention skills, interviewing skills and alternative adjunct therapies.

NURS 464. Global Clinical Learning. 1 Unit.
This course will allow the MSN student to engage in clinical work in low and middle income medically under resourced communities providing direct patient care under clinical supervision of MSN faculty. Students will prepare for the experience by gaining knowledge of the history and culture of the region, common diseases prevalent in the area and orientation to the site operations. The student will focus on the 1) steps to diagnose, treat and implement a plan of care for area specific illnesses; 2) culturally and resource appropriate treatments; 3) dental hygiene and nutrition as they impact the health of the local population. Students will prepare culturally appropriate presentations for local nurses and contribute to the preparation of non-medical members of the team for patient safety using current evidence based practices. Offered as NUNP 464 and NURS 464. Prereq: Enrollment in MSN, DNP or PhD in Nursing Program.

NURS 465. Psychopharmacology. 2 Units.
Course content will focus on drugs commonly used to treat psychiatric disorders and clinical implications for patient and family.

NURS 466. Promoting Health Across Boundaries. 3 Units.
This course examines the concepts of health and boundary spanning and how the synergy of the two can produce new, effective approaches to promoting health. Students will explore and analyze examples of individuals and organizations boundary spanning for health to identify practice features affecting health, compare and contrast practices and approaches, and evaluate features and context that promote or inhibit boundary spanning and promoting health. Offered as MPH 466, PQHS 466, SOCI 466, NURS 466 and BETH 466. Prereq: Graduate student status or instructor consent.

NURS 468. The Continual Improvement of Healthcare: An Interdisciplinary Course. 3 Units.
This course prepares students to be members of interprofessional teams to engage in the continual improvement in health care. The focus is on working together for the benefit of patients and communities to enhance quality and safety. Offered as PQHS 468, MPH 468, and NURS 468.

NURS 473. Advanced Psychopathology Across the Lifespan: Part I (Infant through Young Adult), 2 Units.
The course focuses on the assessment and diagnosis of psychopathology in children of all ages, infants through young adults. Behavioral deviations from normal growth and development will be assessed while considering age, social, cultural, and economic differences. The responses of family members to psychopathology in these age groups will be discussed.

NURS 474. Advanced Psychopathology Across the Lifespan Part II (Adult and Older Adult). 2 Units.
The course focuses on the assessment and diagnosis of psychopathology in adults and older adults. Behavioral/cognitive deviations from normal growth and development will be evaluated while considering socio-cultural differences and age-appropriate behavior. Responses of family members in relation to adults or older adults' psychopathology will be discussed. Prereq: NURS 473.
NURS 475. General Systems Theory: Foundations for Practice. 2 Units.
This foundational seminar introduces General Systems Theory as a framework for understanding complex entities comprised of component parts that are in constant and mutual interaction. The concepts covered will emphasize the openness and flexibility of a system by attending to its entirety as opposed to focusing on separate parts. The focus is on the organizational structure and processes of that system that are circular in nature through cybernetics processes such as feedback loops which allow system adaptation and transformation. These changes enable systems to become more organized and efficient and to develop the capacity to repair themselves. Students will apply General Systems Theory to their disciplines.

NURS 476. Advanced Practice Seminar: Blended Role of Psychiatric-Mental Health APRN. 1 Unit.
Within the context of family and community, students will explore the blended role of the Psychiatric Mental Health Nurse Practitioner and Psychiatric Mental Health Clinical Nurse Specialist. A focus of the course is boundaries and professional development in the blended role. Students will examine ethical, legal, cultural and professional standards as they relate to micro and macro systems.

NURS 481. Family Systems Theoretical Foundations. 2 Units.
This course focuses on the major contemporary theoretical approaches and therapies for conceptualizing and working with families across the lifespan. Attention is given to families challenged by situations such as stress, trauma, violence, psychiatric disorders, and substance abuse. Prereq: NURS 453 and NURS 473 and NURS 475 and NURS 476 or requisites not met permission.

NURS 482. Family Systems Integration and Application. 1 Unit.
This practicum experience in the application of family theory addresses the professional encounter between the advanced practice nurse (APN) and the family system with attention to health promotion and psychiatric disorder management. Special consideration is given to policy, legal, cultural, and ethical issues regarding family care and practice. Group supervision of the practicum experience is an expectation. Prereq: NURS 473 and NURS 475 and NURS 476. Coreq: NURS 474 and NURS 481.

NURS 484. Individual and Group Modalities for Family Systems Practice Across the Lifespan. 3 Units.
This seminar addresses therapeutic modalities and their foundation as they are applied to families across the lifespan. Brief, individual, and group modalities will be studied in the context of Family Systems Theory with a focus on differences in family constellations and developmental stages. The selection of modalities for families will consider the implications of cultural and gender differences, vulnerable populations, and the stigma of psychiatric illness. Prereq: NURS 481 and NURS 482.

NURS 485. Practicum and Supervision: Family Systems Practice Across the Lifespan. 2 Units.
This practicum experience involves the professional encounter between the individual, group members, and nurse therapist within the context of family systems theory. The nurse therapist employs nursing strategies and concepts from psychiatry and behavioral and social sciences related to the promotion of mental health and biopsychosocial treatment in individual and group members across the life span. Attention will be given to situations such as stress, loneliness, trauma, violence, and substance abuse. Group supervision of the practicum experience is an expectation. Prereq: NURS 481 and NURS 482. Coreq: NURS 484.

NURS 486. Modalities for Family Systems Practice: Vulnerable Family Populations. 3 Units.
Within the context of family and community in urban and rural settings, students will explore the special needs of families who are currently manifesting mental health and substance abuse disorders. Examples of vulnerable families include those who have been exposed to acute and chronic stress, natural and man-made disasters, and military-related and other forms of trauma. The needs of youth and adults who are incarcerated will be addressed. Students will encounter the diverse nature of family relationships, including blended, migrant, and immigrant families; relationships that are defined by choice; and families residing on reservations and in religious enclaves. A variety of treatment modalities will be discussed. Prereq: NURS 482 and NURS 485.

NURS 488. Theoretical Basis of Practice and Supervision in Consultation, Collaboration. 2 - 3 Units.
This course focuses on the professional encounter between the nurse consultant-educator and families, work groups, and communities within the context of an environment of care. The nurse consultant-educator applies general systems and family systems theory to enhance the capacity of families to learn, adapt, and develop through mutual interaction and cybernetic processes based on systems theory. The roles of the nurse, educator, researcher, administrator, and therapist supervisor are explored. The theories and processes of consultation, collaboration, and adult education are discussed relative to mental health and community education. Prereq: NURS 484 and NURS 485.

NURS 489. Practicum and Supervision in Role of Family Systems Psych-Mental Health Advanced Practice Nurse. 3 Units.
This practicum course emphasizes the professional encounter between the psychiatric mental health nurse practitioner (NP), families, organizations, communities and agency personnel providing mental health services in the context of an environment of care. Systems variables that influence the learning, adaptation and development of families, organizations and systems are emphasized. The psychiatric nurse clinician functions as a change agent in direct and indirect care through the role of practitioner, educator, consultant, planner, evaluator and researcher. Prereq: NURS 484 and NURS 485. Coreq: NURS 488.

NURS 494. Global Health Seminar. 3 Units.
The focus of this course is the issues and trends in global health from both a nursing and a trans-disciplinary perspective. The course covers how international social, political, economic, environmental, and cultural issues affect health and health care. Particular emphasis is placed on nursing's contribution to global health issues and outcomes. Offered as: NURS 394 and NURS 494.

NURS 502. Inquiry III - Evidence-Based Nursing Practice. 2 Units.
This course focuses on linking research evidence to nursing practice. Processes for implementation and evaluation of evidence-based nursing practice will be included. Prereq: NURS 425 or NUND 404C.

NURS 503. Inquiry Practicum. 1 - 2 Units.
This course focuses on the development of competencies in scientific inquiry. Such competencies are achieved through participation in a research study or evidence-based project related to nursing science with dissemination of the experience. Prereq or Coreq: NURS 502.
NURS 506. Nursing Epistemology. 3 Units.
This course involves the study of knowledge shared among members of the discipline, the patterns of knowing and knowledge development, and criteria for evaluating knowledge claims and philosophy of science. The course is a search and discussion experience aimed at enabling graduate students to become knowledgeable about approaches to the study of disciplines and scientific knowledge development. Forces affecting the development of knowledge, the origins of key terms and concepts, and identification of major themes in nursing will be explored.

NURS 507. Clinical Knowledge. 3 Units.
This course is structured to allow students to develop clinical knowledge about their area of interest and to begin the process of identifying clinical research questions. Supervision for this experience will be twofold. Students will be placed with an expert clinician with a minimum of a master's degree (in nursing) to identify and arrange relevant clinical experiences. The student and the clinician will work with the course faculty to create opportunities for the student to experience the clinical phenomena of interest, which may include actual "hands-on" experience. Students will also meet regularly with the other students in the course and the course faculty for group supervision that focuses on linking practical clinical issues to research questions. Course requirements would include eight hours of practicum experiences per week.

NURS 508. Context of Care. 3 Units.
This course is designed to allow students to explore the social, political, economic, and health care issues that form the context for their clinical phenomena of interest. The intent of this course is for the student to become knowledgeable about the broader forces that affect their clinical problem. Topics might include current research in their field, as well as health policy related to their phenomena, political entities that affect funding, and the regulation of practice in their area of interest. The student will need a content expert to help them plan and coordinate their practicum experiences, which should be multiple and varied, and include exposure to both local and state level entities. Prereq: NURS 507 or equivalent.

NURS 510. Health Disparities. 3 Units.
This course aims to provide theoretical and application tools for students from many disciplinary backgrounds to conduct research and develop interventions to reduce health disparities. The course will be situated contextually within the historical record of the United States, reviewing social, political, economic, cultural, legal, and ethical theories related to disparities in general, with a central focus on health disparities. Several frameworks regarding health disparities will be used for investigating and discussing the empirical evidence on disparities among other subgroups (e.g., the poor, women, uninsured, disabled, and non-English speaking populations) will also be included and discussed. Students will be expected to develop a research proposal (observational, clinical, and/or intervention) rooted in their disciplinary background that will incorporate materials from the various perspectives presented throughout the course, with the objective of developing and reinforcing a more comprehensive approach to current practices within their fields. Offered as CRSP 510, PQHS 510, MPH 510, NURS 510, and SASS 510.

NURS 511. Strategies for Theory Development. 3 Units.
This course examines the nature of theory and strategies for theory development in nursing. Students will explore a variety of strategies and select an approach for beginning theory development that addresses nursing phenomena in their area of interest. Prereq: Admission to PhD nursing program or requisites not met permission.

NURS 518. Qualitative Nursing Research. 3 Units.
This course examines research approaches directed towards the development of nursing knowledge. This course will include methods and issues in data collection, analysis, and critique of research findings. It will focus on the philosophical and epistemological foundations of qualitative research, present an overview of various methodological approaches, examine the criteria for rigor, and analyze ethical issues in qualitative methodologies. Prereq: Admission to PhD nursing program or requisites not met permission.

NURS 521. Advanced Nursing Research II. 3 Units.
The discussion of research designs and their rationale for use will be continued. Principles of measurement, study implementation and data analysis will be discussed. The development of a research proposal will be the expected outcome of this two-semester sequence. Prereq: NURS 401 or STAT 401 and NURS 520.

NURS 522. Advanced Internship in Cardiovascular Nursing. 1 - 5 Units.
This 600-hour internship is designated to provide the master's prepared ACNP-Cardiovascular Nursing Program graduate with the experience needed to enter practice as an APN caring for patients with complex cardiac disorders. Recommended preparation: completion of appropriate NP program. Prereq: NURS 411.

NURS 523. Advanced Internship in Flight Nursing. 1 - 5 Units.
This internship is designed to provide the Master's prepared ACNP-flight nurse concentration graduate with experience needed to qualify for the Certification Examination in Flight Nursing. This experience consists of a 600 hour precepted internship in a flight nursing setting. Recommended preparation: Completion of M.S.N. program focus in Flight Nursing and ACNP certification, certification in ACLS, PALS, and neonatal resuscitation.

NURS 530. Advanced Nursing Research Methods I. 3 Units.
This course focuses on conceptualization of a research problem within a nursing perspective, systematic literature review of a substantive area of research, and the design component of a research study to address scientific gaps. Descriptive, quasi-experimental, experimental, and mixed methods designs will be examined. Threats to internal and external validity will be discussed. The emphasis is on the application of design strategies while encouraging flexibility in conceptualizing a study using different research methods. Coreq: NURS 532 or requisites not met permission.

NURS 531. Advanced Nursing Research Methods II. 3 Units.
This course focuses on sampling, measurement, instrumentation, data management, intervention development, and human subjects' issues. These will be discussed and applied within the context of a scientific study in a substantive area that is consistent with theoretical and empirical knowledge and the nursing perspective. Prereq: NURS 530 and NURS 532 or consent of instructor.

NURS 532. Applied Statistics. 3 Units.
This course provides an advanced overview of the assumptions and applications necessary to analyze and interpret questions and research related to clinical practice. Emphasis will be on statistical interpretation of research. During the course, data management, statistical analysis, and data interpretation, as well as univariate, bivariate, and multivariate statistics such as ANOVA and ANCOVA will be examined. The data analysis process will be examined and deconstructed throughout the course. Prereq: Admission to PhD nursing program or requisites not met permission.
NURS 557. Advanced Midwifery. 6 Units.
In consultation with faculty, students select a nurse-midwifery service where they assume the responsibilities of beginning practitioner for a minimum of 10 weeks of intensive supervised clinical practice. Students synthesize the nurse-midwifery management process while providing continuity of care and integrating all core competency areas. Students explore the professional aspects of nurse-midwifery practice. Historical development of the profession will be emphasized as a framework for understanding current issues related to nurse-midwifery education and practice in the United States. Prereq: NURS 457.

NURS 559. Primary Care in Women's Health. 4 Units.
In this course, students gain knowledge needed to assess and manage primary health care problems commonly encountered by diverse populations of women in ambulatory settings. This course prepares the student to use the problem solving approach to assist individuals with common acute and chronic health problems. Culturally appropriate health promotion and disease prevention are integrated throughout. Students are introduced to the dynamics of the managed care environment. Prereq: NURS 455.

NURS 578. Curriculum and Instruction. 3 Units.
The purpose of this course is to explore the theoretical underpinnings of education and to examine innovative approaches to critical thinking. Students are provided the opportunity to analyze philosophies and principles of education along with teaching and learning styles. The course will focus on curriculum planning and development congruent with the philosophy and objectives of a nursing program. Curriculum development includes determination of program and course objectives, along with selection and organization of appropriate learning experiences to meet these objectives. Techniques for instruction in the classroom, laboratory, and clinical settings are explored.

NURS 601. Special Problems. 1 - 12 Units.
This course is offered, with permission, to Ph.D. students in Nursing undertaking reading in a field of special interest.

NURS 609. Health Care Policy and Planning. 3 Units.
The primary focus of this course is to explore the leadership role of nurses in health policy development and implementation as well as the role of research in health care policy formation and planning. Special emphasis is placed on selected national and international health policy issues that form the socio-political and economic context of nursing care and practice. Ethical dimensions of public policy formulations and implementation are highlighted. Offered as NUND 508 and NURS 609.

NURS 615. Topical Seminar in Health Science Research. 3 Units.
This PhD course is designed to provide an in-depth knowledge of research issues in a given area. Opportunities are provided to apply knowledge for further development of the student's research interests and ideas. An in-depth examination of selected theoretical and methodological approaches to the development of research related to human science will be emphasized. Interrelationships among theory, research, and knowledge from nursing and related disciplines will be explored. Prereq: Admission to PhD nursing program or Requisites Not Met permission.

NURS 619. Theoretical Foundations of Educational Testing and Evaluation. 2 Units.
In this course, an overview of educational measurement and evaluation is provided. Methods of evaluating teaching effectiveness, student learning, and student performance are explored. Prereq: NURS 578.

NURS 621. Teaching Practicum. 1 - 6 Units.
In this preceptored teaching practicum, the student may engage in classroom, laboratory, and clinical teaching assignments in nursing. The student will be expected to use current educational theory and nursing knowledge in completing the practicum experience (minimum 60 hours). Offered as NUND 615 and NURS 621. Prereq: NURS 578, NURS 619, NURS 620. Coreq: NURS 578, NURS 619.

NURS 630. Advanced Statistics: Linear Models. 3 Units.
This course is focused on advanced procedures for data analysis and statistical inference in health research. The course is devoted to discussion and application of linear models, including simple and multiple regression and logistic regression to study design. The role of assumptions and theory in guiding the analysis plan is emphasized through lecture, readings, and critical evaluation of published research in the student's area of interest. Prereq: NURS 532 or Requisites Not Met permission.

NURS 631. Advanced Statistics: Multivariate Analysis. 3 Units.
This course focuses on selected advanced multivariate topics and procedures in health research. Topics will be covered through lecture, readings, computer analysis as well as critical analysis of published research in the health sciences fields. Topics to be covered in this course include: survival analysis, factor analysis, path analysis, repeated measures ANOVA and advanced regression techniques (logistic, loglinear, mixed models). Prereq: NURS 630 or Requisites Not Met permission.

NURS 632. Advanced Statistics: Structural Equation Modeling. 3 Units.
This course focuses on advanced data analytic procedures using structural equation modelings (SEM) in health research. Content will be explored through lecture, computer analysis, and critical analysis of relevant research. Topics covered in this course include: SEM with latent variables, path analysis adjusting for measurement error, nested models, and advanced SEM techniques, e.g., exploratory SEM, autoregressive models, latent growth curves, and latent class analysis using mixture modeling. Prereq: NURS 630 or Instructor Consent

NURS 671. Proposal Development. 1 - 6 Units.
Provides an opportunity for guided development of a candidacy proposal through planned contact with a designated committee of faculty members. The aim is to assist the student in the development of a refined proposal with strong scientific merit. The course should be utilized only by those with a candidacy proposal statement. Minimum 3 hours required for progression in program.

NURS 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.
JACK, JOSEPH AND MORTON MANDEL SCHOOL OF APPLIED SOCIAL SCIENCES

The Jack, Joseph and Morton Mandel School of Applied Social Sciences (http://msass.case.edu) offers curricula leading to the Master of Science in Social Administration (MSSA) degree in social work, Master of Nonprofit Organization (MNO) and to the Doctor of Philosophy (PhD) degree in social welfare.

Mission and Vision

Our Mission

Advancing leadership in social work and nonprofit education, scholarship, and service to build a more just world.

Our Vision

Students are central to what we do, and they actively participate and contribute to a dynamic learning community that develops leaders of social change in direct practice, community practice and nonprofit management.

The Mandel School was founded by and for the Greater Cleveland community in the belief that a university-based school of social work would transform the work of people and organizations to achieve to their full potential. As the Mandel School celebrates its centennial, we reaffirm our historical commitment to the application of social science for improving social welfare, and seek to continue to broaden the national and international reach of our research, teaching, and service. Our graduates are prepared to be future leaders who turn knowledge into action that furthers health, well being, and social justice.

A History of Innovation

Ranked among the nation’s top ten graduate schools of social work by U.S. News and World Report, and ranked number one in Ohio, the Jack, Joseph and Morton Mandel School of Applied Social Sciences has always committed itself to learning from and fostering the best in social work practice and to building social work’s knowledge base. Since its founding in 1915 as the nation’s first university-affiliated professional graduate school of social work, the Mandel School has been an innovator in professional education, where educators, researchers and practitioners work side-by-side to investigate, study and disseminate knowledge to bridge the gap between the classroom and communities in which social workers practice.

The Mandel School provides students with a solid foundation designed to build core competencies with its innovative Ability-Based Learning Environment, which allows graduates a great degree of flexibility and portability. Students choose concentrations in either Community Practice for Social Change or Direct Practice, which offers specializations in Aging; Alcohol and Other Drug Abuse; Children, Youth and Families; Health; and Mental Health. Certificate programs include gerontology, global health, management and leadership, nonprofit management and school social work. Dual-degree programs enable Mandel School students to obtain their social work degree concurrently with a master’s degree in bioethics, business, law, nonprofit management and public health.

Founded 30 years ago as one of the first nonprofit management programs in the nation, the MNO program has been at the forefront of training future nonprofit leaders. It provides the essential tools needed to lead a nonprofit, carry out its mission ethically and effectively and contribute to society’s betterment. The Master of Nonprofit Management (MNO) is a 39 hour degree program comprised of 27 hours of required coursework and 12 hours of electives.

The Mandel School believes that advanced practitioners are strategists of change, working in partnership with others to enhance the caring capacity of communities. The concentrations structure cross-trains Mandel School students, who build foundations in both areas that bring a breadth of knowledge to their work lives, allowing them the flexibility to pursue their interests even as they change over time. The school prepares advanced practitioners who become lifelong learners with the abilities needed to practice ethically and effectively with diverse populations and with systems of various sizes and types. Students learn to understand the dynamics of problematic social situations and to identify the strengths and resources in individuals, families and communities that offer the best solutions. The school is committed to a vision of social work practice as a force of social justice, empowerment, and the building of healthy communities. That commitment extends beyond our national borders with the Mandel School’s award-winning program of international study options.

The Mandel School counts among its alumni many prominent educators, government officials, accomplished practitioners, researchers, advocates, public-policy-makers, and chief executives of national and regional agencies. Faculty achievements in professional organizations, research, and agency consultation further extend the school’s reputation as an active participant in the advancement of social work practice.

A Mandel School education is more than preparation. It is an opportunity to join a national network of scholars and practitioners who are shaping the course of social work in communities throughout the world. The Mandel School is ranked seventh in faculty productivity among social work schools by Academic Analytics.

For nearly one hundred years, the Jack, Joseph and Morton Mandel School of Applied Social Sciences has stood at the forefront of social work education, introducing innovations in teaching, research, and practice at every step of the way, with an approach that integrates theory and practice like no other.

Mandel students take their places alongside long-time professionals in a variety of social work and nonprofit management arenas understanding firsthand the challenges of social work and non profit management and sharing in its rewards. In a broad spectrum of local and regional organizations, students develop skills in direct practice, policy analysis and development, research, management and community development, and in leading nonprofit organizations.

Accreditation and Licensure

The Jack, Joseph and Morton Mandel School of Applied Social Sciences is accredited by the Council on Social Work Education and the Ohio Chemical Dependency Professionals Board of Ohio.

The Master of Science in Social Administration (MSSA), the social work master’s degree program (MSW for many other programs), at the Jack, Joseph and Morton Mandel School of Applied Social Sciences is accredited by the Council on Social Work Education, a nationally
recognized professional accrediting association for social work graduate and undergraduate programs.

The Jack, Joseph and Morton Mandel School of Applied Social Sciences’ Alcohol and Other Drug Abuse (AODA) curriculum is accredited by the Ohio Chemical Dependency Professionals Board of Ohio. The accreditation indicates that the AODA curriculum meets the formal master's degree education requirements for the top level of licensed independent chemical dependency counselors in Ohio.


The Master of Science in Social Administration (MSSA) degree fulfills part of the requirements of social work licensure in fifty (50) states in the United States. For further information about various licensing requirements by state, visit the website of the Association of Social Work Boards (ASWB) (https://www.aswb.org?).

The Master of Nonprofit Organizations (MNO) Degree Program is a recognized member of Nonprofit Academic Centers Council (NACC).

**Administration**

Grover Cleveland Gilmore, PhD  
**Jack, Joseph and Morton Mandel Dean in Applied Social Sciences and Professor**

Sharon E. Milligan, PhD  
**Associate Dean, Academic Affairs; Chair, Master’s Program; Associate Director of the Center on Urban Poverty and Community Development**

Elizabeth M. Tracey, PhD  
**Associate Dean, Research and Training**

Karen A. Powers, MBA  
**Associate Dean, Finance and Administration**

David Biegel, PhD  
**Chair, Doctoral Program**

Scott Wilkes, PhD  
**Assistant Dean, Academic Affairs**

Andrea G. Porter, MSSA  
**Assistant Dean, Student Services, Director, Office of Student Services**

Sarah Andrews, MSSA  
**Director, School Social Work**

Rachel Blake  
**Assistant Director, Finance**

Tracey Bradnan  
**Director of Communications and Marketing**

Mark Chupp, PhD  
**Director, International Education Programs**

Matthew Colver  
**Assistant Director, Financial Aid**

Claudia J. Coulton, PhD  
**Co-Director, Center on Urban Poverty and Community Development**

Nada Difranco  
**Director of Alumni Relations and Development**

Rashonda Clay-Douthit, PhD  
**Assistant Director Online Field Education**

Debra Fields  
**Registrar**

Robert L. Fischer, PhD  
**Co-Director, Center on Urban Poverty and Community Development, Director, Management of Nonprofit Organizations Degree Program**

Daniel J. Flannery, PhD  
**Director, Begun Center for Violence Prevention Research and Education**

Carmelo Franchina, BA  
**Director, Office of Information Technology**

David Hussey, PhD  
**Associate Director, Begun Center for Violence Prevention Research and Education, Director, Mandel Leadership Fellows Program**

Lenore A. Kola, PhD  
**Co-Director, Ohio Substance Abuse and Mental Illness Coordinating Center of Excellence**

Amy Korsch-Williams, MSSA  
**Director of Field Education**

Marianne Lax, MSSA  
**Director of Charitable Giving, Interim Associate Dean Institutional Advancement and Development**

Gerald Mahoney, PhD  
**Director, Center on Interventions for Children and Families**

LaShon Sawyer, PhD  
**Director Online Education**

Richard Sigg  
**Director of Recruitment and Enrollment**

Mark Singer, PhD  
**Deputy Director, Begun Center for Violence Prevention Research and Education, Co-Director, Center on Substance Abuse and Mental Illness**

Samantha C. Skutnik, MLS  
**Director, Lillian F. & Milford J. Harris Library**

Gerald A. Strom, MSW  
**Director, Intensive Weekend Program**

Melissa Van  
**Assistant Director Human Resources**

Zoe Breen Wood, PhD  
**Director, Office of Educational Assessment**

Craig M. Zullig  
**Director, Office of Research Administration**
Master of Science in Social Administration (MSSA) & Master of Nonprofit Organizations (MNO)

Master of Science in Social Administration (MSSA)
The Master of Science in Social Administration (MSSA) program prepares students for advanced social work practice in a variety of settings. The master’s curriculum is designed to address the wide range of skills and functions required of a professional social worker. Mandel School students are instructed on the various theories of individual and group behavior as well as community systems theory. The application of this knowledge, along with the appropriate use of practice principles and techniques, is a major educational objective.

The curriculum is divided into two levels: foundation and advanced. The foundation curriculum (27 credit hours) includes the knowledge, values, processes, and skills essential for the general practice of social work. It consists of general courses in social work methods, human development theory, social policy, research methods, and an introductory semester of field education. The advanced curriculum (33 credit hours) builds on the professional foundation and provides for advanced knowledge and practice skills in the concentration selected by the student. Concentrations include the following: aging; alcohol and other drug abuse; children, youth and families; health; mental health; and community development. School social work is available as a special emphasis.

Ability Based Learning Environment (ABLE)
The MSSA program incorporates an ability-based learning environment that enables students to develop and demonstrate mastery of eight core social work abilities. Classroom courses and field education are designed to help students develop each ability and continuously assess their learning throughout the educational experience. Mastery of the abilities is demonstrated in the field practicum and documented in a cumulative learning portfolio.

- Identify as a Reflective Professional Social Worker: Students will demonstrate an awareness of the potential influence of their actions and words as a professional social worker upon individuals, families, groups, organizations and communities. Students will demonstrate the ability to reflect on practice decisions and activities, using self-correction to assure continual professional development.
- Advocate for Social, Economic and Environmental Justice: Graduates will advocate for human rights and social and economic justice as one of their primary responsibilities.
- Apply Social Work Methods: Graduates of the MSASS master’s program are prepared to function as advanced practitioners in a changing arena of social work and social welfare. They are able to engage clients and client systems, assess client needs and strengths, provide or help arrange needed services and support, weigh intervention alternatives, implement change strategies, and evaluate results.
- Uphold Social Work Values and Ethics: Students will integrate social work values and ethics into their learning and professional practice.
- Integrate Cultural, Economic and Global Diversity: Students will integrate into their practice the knowledge, skills, and values needed for understanding and appreciation of a diverse world, and for ongoing development of competence in working with diverse populations and settings.
- Think Critically About Theory and Research Knowledge: Graduating students will be able to think critically about their practice and its knowledge base, and about the social problems and situations they encounter. Critical thinking in social work includes selecting appropriate theoretical approaches and strategies to apply in practice, using research findings to improve practice, evaluating one’s own practice, and making contributions to knowledge in the field.
- Communicate Effectively: Graduating students will have the oral, written, nonverbal, and information technology skills that will enable them to communicate effectively and appropriately in professional roles and settings.
- Develop as a Social Work Leader: Social workers recognize that the context of practice is dynamic, and use knowledge and skill to respond proactively. Social work leaders are informed, resourceful, and proactive in responding to evolving organizational, community, societal and global contexts at all levels of practice in ways that improve quality of life.

Mandel School faculty place a high priority on the integration of theory with practice. To facilitate this integration, field work is done concurrent with course work. Through field education, students have the opportunity to acquire new skills and apply their classroom learning in their practice setting. The school is affiliated with over 350 agencies in the Greater Cleveland area, creating a vast network of field education as well as employment opportunities. Students are required to complete over 1000 clock hours of field education. The school and the affiliated agency or field setting agree on the content and conditions of field education, including the qualifications of social workers who serve as field instructors. Field placement decisions are based on educational criteria, with student interests and career objectives taken into consideration.

Concentrations
- Community Practice for Social Change
- Direct Practice

Direct Practice Specializations
- Aging*
- Alcohol and Other Drug Abuse
- Children, Youth and Families
- Mental Health
- Health*

*Offered only in the full-time format.

Program Options

Campus Based Weekly Program
Approximately one-half of Mandel School students are enrolled in the Campus-Based Weekly Program. This program takes four semesters to complete. Students enroll for fall and spring semesters and are scheduled concurrently for classes and field work on a full-time basis. This program is demanding in depth and scope of experience. It is not advisable for students to assume extensive employment during their semesters of enrollment.

Advanced Standing Program
Advanced standing may be granted to students who have earned an Bachelor’s degree in Social Work (BSW) within the last seven years from an institution accredited by the Council on Social Work Education.
Students must have earned a B or better in any social work course for which advanced standing is sought.

**Intensive Weekend Program**
The Intensive Weekend Program is designed to provide graduate-level education toward the MSSA to employed professionals who are maintaining full-time employment. Classes meet one weekend per month throughout the calendar year. Students are required to attend all classes. Students complete five courses each year and all program requirements in three years. Those who have graduated from an accredited BSW program in the last seven (7) years can complete the Intensive Weekend Program in two years.

**Senior Year in Professional Studies Program**
Undergraduate students of superior ability and achievement may be admitted to the Mandel School at the end of their junior year. This program enables qualified college seniors who are majoring in social work related fields to begin their first year of graduate study during what would normally be their last year of undergraduate work. Exceptional undergraduate students who are firmly committed to social work as a profession can earn both their undergraduate and graduate degrees in five years.

A student in the Senior Year in Professional Studies Program is permitted to substitute the first year (31 semester hours) at the Mandel School for the last year of undergraduate work. The bachelor’s degree will be granted by the undergraduate college when the student has completed his or her first year at the Mandel School.

Students applying for this program must be interviewed by an admissions officer as part of the application process to explore the candidate’s level of maturity, knowledge of social work, and readiness for professional education. Application for this program should be made prior to the second semester of the junior year.

To qualify for this program, students must demonstrate superior academic ability and achievement during their first three years of undergraduate study. All applicants must (a) have sufficient coursework in the social and behavioral sciences by the end of their junior year; (b) hold a cumulative grade point average of at least 3.25; and (c) have successfully completed three-quarters of the major and minor courses in their area of concentration. Acceptance into the Senior Year in Professional Studies Program is contingent upon receipt of a written statement from the dean of the applicant’s undergraduate college, outlining any remaining requirements.

Note: This program is available to students at Case Western Reserve University, Hiram College, College of Wooster, Baldwin Wallace University, John Carroll University, Fisk University, and Ohio Northern University by joint agreement with these institutions. Interested students from other institutions are encouraged to speak with the director of admissions.

**Part-Time Degree Program**
Students may opt to complete their degree work on a part-time basis during their first year. During the second, third, and fourth years students complete field education requirements and carry a full-time, or nearly full-time, load.

Part-time students select classes from the full-time weekday schedule. These classes meet once a week for two hours. Employed professionals may participate in this program if they can arrange a flexible work schedule.

The part-time program may be completed in three years. Students granted advanced standing may complete the program in fewer semesters. Part-time students are required to register for a minimum of six credit hours per semester. A student must complete all degree requirements in a maximum of five years.

**Non-Degree Study**
Some designated courses may be taken on a non-degree basis with the permission of the assistant dean of academic affairs and the course instructor. A maximum of 12 hours earned on a non-degree basis may be counted toward requirements for the master’s degree if the student is subsequently admitted as a degree seeking candidate. A bachelor’s degree is required for enrollment.

**Online MSSA Program**
The Online MSSA Program option is designed to provide online graduate social work education for employed professionals who plan to maintain full-time employment. Classes meet online to complete all program requirements in two years for advanced standing, and three years for non-advanced standing.

**Undergraduate Social Work Minor**
The Social Work minor offers interdisciplinary collaborative learning that includes service, community engagement, and an exploration of values. Students experience active learning that is practical and applied to real-world settings. The minor integrates social work theory and practice, social policy, socio-behavioral theory and research to understand and address complex social problems of our time, domestically and internationally. Some issues covered in the courses include oppression and privilege, poverty, violence, social justice, alcohol and other drug abuse, social welfare, community development, children, youth, and families. Courses can be taken on campus or through the MSASS international study and travel courses.

**Master of Nonprofit Organizations Degree Program (MNO)**
The Master of Nonprofit Organizations (MNO) degree program prepares students interested in the nonprofit sector for management and leadership positions, by building their skills, competencies, knowledge and capacity. The MNO degree has five program educational objectives for its graduates: (1) to bring contextual understanding to managerial decision-making; (2) to develop, analyze and apply relevant data; (3) to inspire and engage volunteers and professionals in the creation and implementation of ethically-grounded strategies to advance organizational mission; (4) to develop and implement revenue generation strategies; and (5) to manage human and financial resources effectively, efficiently and ethically.

The full time program consisting of thirty-nine (39) credit hours can be completed in twelve (12) months over three (3) consecutive semesters, with students beginning each year in the summer semester (June 1) and concluding at University graduation in the following May.

The curriculum will provide education that instills analytical skills, knowledge relevant to ethical and entrepreneurial decision-making, and expertise in acquiring and managing resources. Graduates will be trained to enhance organizational effectiveness, harness passion, dedication, and vision, make the best use of available resources and seek new resources. Graduates will gain hard and soft management skills and knowledge needed to address a wide range of issues confronting nonprofits and become professionals who work to influence political and
social decisions, create stronger organizations, building the capacity, and
advancing the mission.

Students accepted for the MNO degree program must possess a
bachelor's degree from an accredited college or university. They must
have a record of excellent academic performance and potential evidenced
by grade point average. Applicants with a GPA below 2.7 must take
the Graduate Record Examination (GRE) or the Miller Analogies Test
(MAT) as a condition of admission. Students must also show evidence
of a strong interest in the nonprofit sector through volunteer activities,
internship experiences, or employment in a nonprofit organization.

**Advanced Standing Program**

The Advanced Standing Program leading to a Master of Science in Social
Administration (MSSA) is available to students who obtained a strong
academic record in their Bachelor of Science (BSW) program

Up to 24 credits hours of advanced standing may be granted toward
the MSSA degree and students can complete the MSSA program in
just 36 credit hours. Your BSW must have been earned within the last
seven years from a Council on Social Work Education (CSWE) accredited
institute with grades of B or better in all social-work-related courses.

Advanced standing students in any concentration may receive transfer
credit for up to 24 credit hours of foundation courses listed below:

**Foundation Courses**

<table>
<thead>
<tr>
<th>Transfer Credit Received</th>
<th>OR Enroll at Mandel School</th>
</tr>
</thead>
<tbody>
<tr>
<td># SASS 426: Research Methods in Social Work (3 Crs)</td>
<td># Spring (year:__________)</td>
</tr>
<tr>
<td># SASS 440: Human Development I: Child and Adolescent (3 Crs)</td>
<td># Fall (year:__________)</td>
</tr>
<tr>
<td># SASS 441: Human Development II: Adult (3 Crs)</td>
<td># Spring (year:__________)</td>
</tr>
<tr>
<td># SASS 470: Social Policy (3 Crs)</td>
<td># Fall (year:__________)</td>
</tr>
<tr>
<td># SASS 477: Direct Practice Foundation Methods and Skills (3 Crs)</td>
<td># Fall (year:__________)</td>
</tr>
<tr>
<td># SASS 478: Macro and Policy Practice Skills (3 Crs)</td>
<td># Spring (year:__________)</td>
</tr>
<tr>
<td># SASS 484: Theories of Oppression and Social Justice (3 Crs)</td>
<td># Fall (year:__________)</td>
</tr>
<tr>
<td># SASS 601: Field Education (2 Crs)</td>
<td># Fall (year:__________)</td>
</tr>
<tr>
<td># SASS 495: Field Education Seminar (1 Crs)</td>
<td># Fall (year:__________)</td>
</tr>
</tbody>
</table>

Total Credit Hours from Advanced Standing:_______ (24 possible)

**Pattern of Enrollment: Advanced Standing - Alcohol & Other Drug Abuse Plus-Chemical Dependency Professional License Eligibility OPTION 1(Alcohol)**

<table>
<thead>
<tr>
<th>Plan of Study</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Education II (SASS 602)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aging Policy and Service Delivery (SASS 513)</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Problem Identification, Screening and Assessment/Diagnosis (SASS 547)</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Theory/Practice Approaches in Direct Practice Social Work (SASS 549)</td>
<td></td>
<td>3</td>
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</tbody>
</table>

Social Work Practice with Older Adults (SASS 581)
Field Education III (SASS 603) 3
Practice Evaluation (SASS 530) 3
Social Work with Death, Grief and Loss (SASS 518) (or another Elective)
Elective 3
Elective 3
Field Education IV (SASS 604) 3
Elective 3
Year Total: 15 15 6

Total Units in Sequence: 36

**OPTION 2 (Aging)**

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Education II (SASS 602)</td>
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<td></td>
</tr>
<tr>
<td>Aging Policy and Service Delivery (SASS 513)</td>
<td>3</td>
<td></td>
</tr>
<tr>
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<td>3</td>
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<tr>
<td>Theory/Practice Approaches in Direct Practice Social Work (SASS 549)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Social Work Practice with Older Adults (SASS 581)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
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</tr>
</tbody>
</table>

Year Total: 12 12

Total Units in Sequence: 36

**Pattern of Enrollment: Advanced Standing - Alcohol & Other Drug Abuse Plus-Chemical Dependency Professional License Eligibility OPTION 1(Alcohol)**

<table>
<thead>
<tr>
<th>Plan of Study</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
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<tbody>
<tr>
<td>Field Education II (SASS 602)</td>
<td>3</td>
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<tr>
<td>Problem Identification, Screening and Assessment/Diagnosis (SASS 547)</td>
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<td>Theory/Practice Approaches in Direct Practice Social Work (SASS 549)</td>
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<tr>
<td>Social Work Practice in Alcohol and Other Drug Abuse (SASS 564)</td>
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<tr>
<td>Social Work Intervent in Co-occurring Mental and Substance Abuse Disor (SASS 562) (or another Elective)</td>
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<tr>
<td>Course Description</td>
<td>Units</td>
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<td>-----------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Field Education III (SASS 603)</td>
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<td></td>
</tr>
<tr>
<td>Practice Evaluation (SASS 530)</td>
<td>3</td>
<td></td>
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<tr>
<td>Social Work with Groups (SASS 585) (or another Elective)</td>
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<tr>
<td>Alcohol and Other Drug Abuse Policy and Service Delivery (SASS 516) (Intensive Weekend Format)</td>
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<tr>
<td>Integrative Seminar in Alcohol and Other Drug Abuse Treatment (SASS 576) (Intensive Weekend Format)</td>
<td>3</td>
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<tr>
<td>Field Education IV (SASS 604)</td>
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<td></td>
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<tr>
<td>Elective</td>
<td>3</td>
<td></td>
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<tr>
<td><strong>Year Total:</strong></td>
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<tr>
<td><strong>Total Units in Sequence:</strong></td>
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</table>

**OPTION 2 (Alcohol)**

**First Year**

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Units</th>
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<tbody>
<tr>
<td>Field Education II (SASS 602)</td>
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<tr>
<td>Social Work Practice in Alcohol and Other Drug Abuse (SASS 564)</td>
<td>3</td>
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<tr>
<td>Problem Identification, Screening and Assessment/Diagnosis (SASS 547)</td>
<td>3</td>
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<tr>
<td>Theory/Practice Approaches in Direct Practice Social Work (SASS 549)</td>
<td>3</td>
</tr>
<tr>
<td>Field Education III (SASS 603)</td>
<td>3</td>
</tr>
<tr>
<td>Practice Evaluation (SASS 530)</td>
<td>3</td>
</tr>
<tr>
<td>Alcohol and Other Drug Abuse Policy and Service Delivery (SASS 516) (Intensive Weekend Format)</td>
<td>3</td>
</tr>
<tr>
<td>Integrative Seminar in Alcohol and Other Drug Abuse Treatment (SASS 576) (Intensive Weekend Format) or Motivational Interviewing (SASS 522) or another Elective</td>
<td>3</td>
</tr>
<tr>
<td><strong>Year Total:</strong></td>
<td>12</td>
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</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course Description</th>
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**Total Units in Sequence:** 36

**OPTION 2 (Children)**

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**Total Units in Sequence:** 36
### Pattern of Enrollment: Advanced Standing- Community Practice for Social Change

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Total Units in Sequence: 36

### Pattern of Enrollment: Advanced Standing-Health

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Total Units in Sequence: 36

### OPTION 2 (Community Practice)

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Total Units in Sequence: 36

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Total Units in Sequence: 36
Pattern of Enrollment: Advanced Standing- Mental Health (Adults)

**OPTION 1 (Mental Health-Adults)**

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**Pattern of Enrollment: Advanced Standing- Mental Health-Children and Adolescent**

**OPTION 1 (Mental Health-Children)**

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**Total Units in Sequence:**

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**OPTION 2 (Mental Health-Children)**

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Pattern of Enrollment: Advanced Standing- Children, Youth & Families-School Social Work

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Total Units in Sequence: 45

Intensive Weekend Program

The Intensive Weekend program offers human service professionals who are employed full time to pursue a Master of Science in Social Administration (MSSA). Classes meet one weekend per month through the calendar year and students are required to attend all classes. Students complete four courses each year (six during the first year), and complete all program requirements in three years.

Courses consists of three distinct components:

- A two-day weekend of classes once per month (Saturday and Sunday, 9:00 a.m.-6:00 p.m.)
- A four-week study period, during which additional readings and written assignments are completed
- A final study period of approximately three weeks, during which the final course assignment is completed and materials for the next course are received.

### Alcohol & Other Drug Abuse

#### First Year

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Total Units in Sequence: 60

1 Baldwin Wallace University course
## Children, Youth and Families

### First Year

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**Total Units in Sequence:** 60

## Mental Health-Adult

### First Year

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### Second Year

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### Third Year

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**Total Units in Sequence:** 60

### Intensive Weekend Advanced Standing

The Intensive Weekend program offers human service professionals who are employed full-time to pursue a Master of Science in Social Administration (MSSA). Classes meet one weekend per month through the calendar year and students are required to attend all classes. Up to 24 hours of advanced standing may be granted to students who have completed their bachelor’s degree in social work (BSE) in the last seven years from an institution that is accredited by the Council on Social Work Education (CSWE). Grades of B or better must have been attained in all core social work courses.

Intensive weekend advanced standing students may receive transfer credit for up to 24 credit hours of foundation courses listed below:
Foundation Courses

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<td># SASS 601: Field Education (2 Crs)</td>
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<td># SASS 495: Field Education Seminar (1 Cr. Hr.)</td>
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Total Credit Hours from Advanced Standing:______ (24 possible)

Alcohol and Other Drug Abuse

First Year

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Year Total: 9 6 6

Second Year

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Year Total: 6 9

Total Units in Sequence: 36

Children, Youth and Families

First Year

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Year Total: 9 6 6

Second Year

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Year Total: 6 9

Total Units in Sequence: 36

Mental Health: Adult

First Year

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Year Total: 9 6 6

Second Year

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Year Total: 9 6 6

Total Units in Sequence: 36
Master of Science in Social Administration (MSSA) & Master of Nonprofit Organizations (MNO)

Integrative Seminar in Alcohol and Other Drug Abuse Treatment (SASS 576)

Year Total: 6 9

Total Units in Sequence: 36

Full-Time Program

The Full-Time program takes four semesters to complete. Students are scheduled for classes and field education concurrently. In the first two semesters, students complete foundation courses which are prerequisites for concentration required courses. Advanced electives are completed in the last two semesters.

Aging

First Year

Field Education I (SASS 601) 2
Theories of Oppression and Social Justice (SASS 484) 3
Human Development I: Child and Adolescent (SASS 440) 3
Social Policy (SASS 470) 3
Field Education Seminar (SASS 495) 1
Direct Practice Generalist Methods & Skills (SASS 477) 3
Field Education II (SASS 602) 3
Human Development II: Adult (SASS 441) 3
Macro and Policy Practice Skills (SASS 478) 3
Research Methods in Social Work (SASS 426) 3
Problem Identification, Screening and Assessment/Diagnosis (SASS 547) 3
Year Total: 15 15

Second Year

Field Education III (SASS 603) 3
Social Work Practice in Alcohol and Other Drug Abuse (SASS 564) 3
Practice Evaluation (SASS 530) 3
Social Work Intervent in Co-occurring Mental and Substance Abuse Disor (SASS 562) (or Free Elective) 3
Theory/Practice Approaches in Direct Practice Social Work (SASS 549) 3
Field Education IV (SASS 604) 3
Free Elective 3
Alcohol and Other Drug Abuse Policy and Service Delivery (SASS 516) 3
Integrative Seminar in Alcohol and Other Drug Abuse Treatment (SASS 576) (Intensive Weekend Format only) 3
Free Elective 3
Year Total: 15 15

Total Units in Sequence: 60

Alcohol & Other Drug Abuse

First Year

Units

Field Education I (SASS 601) 2
Direct Practice Generalist Methods & Skills (SASS 477) 3
Theories of Oppression and Social Justice (SASS 484) 3
Human Development I: Child and Adolescent (SASS 440) 3
Social Policy (SASS 470) 3
Field Education Seminar (SASS 495) 1
Field Education II (SASS 602) 3
Human Development II: Adult (SASS 441) 3
Macro and Policy Practice Skills (SASS 478) 3
Research Methods in Social Work (SASS 426) 3
Problem Identification, Screening and Assessment/Diagnosis (SASS 547) 3
Year Total: 15 15

Second Year

Units

Field Education III (SASS 603) 3
Social Work Practice in Alcohol and Other Drug Abuse (SASS 564) 3
Practice Evaluation (SASS 530) 3
Social Work Intervent in Co-occurring Mental and Substance Abuse Disor (SASS 562) (or Free Elective) 3
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Free Elective 3
Alcohol and Other Drug Abuse Policy and Service Delivery (SASS 516) 3
Integrative Seminar in Alcohol and Other Drug Abuse Treatment (SASS 576) (Intensive Weekend Format only) 3
Free Elective 3
Year Total: 15 15

Total Units in Sequence: 60

Children, Youth, and Families

First Year

Units

Field Education I (SASS 601) 2
Direct Practice Generalist Methods & Skills (SASS 477) 3
Theories of Oppression and Social Justice (SASS 484) 3
Human Development I: Child and Adolescent (SASS 440) 3
Social Policy (SASS 470) 3
Field Education Seminar (SASS 495) 1
Free Elective 3
Year Total: 15 15

Total Units in Sequence: 60
Field Education II (SASS 602)                  3
Human Development II: Adult (SASS 441)         3
Macro and Policy Practice Skills (SASS 478)     3
Research Methods in Social Work (SASS 426)     3
Problem Identification, Screening and Assessment/Diagnosis (SASS 547) 3
Year Total:                                    15  15

Second Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
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<tbody>
<tr>
<td>Field Education III (SASS 603)</td>
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<tr>
<td>Child and Families in the School Setting (SASS 519)</td>
<td>3</td>
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<tr>
<td>Theory/Practice Approaches in Direct Practice Social Work (SASS 549)</td>
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<td>Trauma Informed Social Work Practice with Children &amp; Families (SASS 550)</td>
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<td>Family System Interventions (SASS 517)</td>
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<td>Child and Family Policy and Service Delivery (SASS 529)</td>
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Total Units in Sequence:                           69

Community Practice for Social Change

First Year

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<td>Social Policy (SASS 470)</td>
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<td>Direct Practice Generalist Methods &amp; Skills (SASS 477)</td>
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<tr>
<td>Theories of Oppression and Social Justice (SASS 484)</td>
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<td>Human Development I: Child and Adolescent (SASS 440)</td>
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<td>Social Policy (SASS 470)</td>
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<tr>
<td>Human Development II: Adult (SASS 441)</td>
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<tr>
<td>Macro and Policy Practice Skills (SASS 478)</td>
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<td>Research Methods in Social Work (SASS 426)</td>
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| Problem Identification, Screening and Assessment/Diagnosis (SASS 547) 3
| EDU 510 (Baldwin Wallace)                     | 3    |        |
| EDU 584 (Baldwin Wallace)                     | 3    |        |
| EDU 573 (Baldwin Wallace)                     | 3    |        |
| Year Total:                                   | 15   | 15     |

Second Year

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<tr>
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<tr>
<td>Field Education III (SASS 603)</td>
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<tr>
<td>Legislative and Political Process (SASS 512) (or Free Elective)</td>
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<tr>
<td>Theoretical Contexts Shaping Community Practice (SASS 534)</td>
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<td>Assessing, Building &amp; Organizing Community (SASS 567)</td>
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<td>Field Education IV (SASS 604)</td>
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<td>Needs Assessment and Program Evaluation (SASS 532)</td>
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<td>Planning &amp; Implementing Social Change (SASS 569)</td>
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### Health

#### First Year

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<td>Theories of Oppression and Social Justice (SASS 484)</td>
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<td>Human Development I: Child and Adolescent (SASS 440)</td>
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<td>Social Policy (SASS 470)</td>
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<td>Field Education Seminar (SASS 495)</td>
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<td>Field Education II (SASS 602)</td>
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<td>Human Development II: Adult (SASS 441)</td>
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<tr>
<td>Macro and Policy Practice Skills (SASS 478)</td>
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<tr>
<td>Research Methods in Social Work (SASS 426)</td>
<td>3</td>
</tr>
<tr>
<td>Problem Identification, Screening and Assessment/ Diagnosis (SASS 547)</td>
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<td>Year Total:</td>
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#### Second Year

<table>
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<th>Course</th>
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<tr>
<td>Social Work Practice in Mental Health Adults (SASS 583)</td>
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<td>Trauma Informed Social Work Practice with Children &amp; Families (SASS 550)</td>
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<td>Practice Evaluation (SASS 530)</td>
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<td>Field Education IV (SASS 604)</td>
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<td>Integrative Seminar in Mental Health: Adults (SASS 587)</td>
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Total Units in Sequence: 60

### Mental Health-Adult

#### First Year

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Total Units in Sequence: 60

### Mental Health-Child

#### First Year

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<tr>
<td>Direct Practice Generalist Methods &amp; Skills (SASS 477)</td>
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</tr>
<tr>
<td>Theories of Oppression and Social Justice (SASS 484)</td>
<td>3</td>
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<td>Human Development I: Child and Adolescent (SASS 440)</td>
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<td>Social Policy (SASS 470)</td>
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<td>Human Development II: Adult (SASS 441)</td>
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<td>Macro and Policy Practice Skills (SASS 478)</td>
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<td>Research Methods in Social Work (SASS 426)</td>
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<td>Problem Identification, Screening and Assessment/ Diagnosis (SASS 547)</td>
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<td>Year Total:</td>
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</table>
Dual Degree Programs

Dual and Interdisciplinary Degree Programs

Dual and interdisciplinary degree programs are available to full-time students only.

Master of Science in Social Administration and Law (MSSA/JD)

The dual-degree program established by the Jack, Joseph and Morton Mandel School of Applied Social Sciences and the university's School of Law makes it possible for selected full-time students to pursue an integrated program of studies to receive the Master of Science in Social Administration (MSSA) and Juris Doctor (JD) degrees within four years rather than the normal five years. Applicants for the dual-degree program must apply to and meet the admission requirements of both professional schools and are encouraged to apply for admission to both programs simultaneously. Dual-degree students must receive the MSSA and JD degrees simultaneously to be granted credit for specific courses taken in the other program.

Master of Science in Social Administration and Business (MSSA/MBA)

The Jack, Joseph and Morton Mandel School of Applied Social Sciences and the Weatherhead School of Management offer a dual-degree program leading to the Master of Science in Social Administration (MSSA) with the Master of Science in Business Administration (MBA). The program is designed for candidates who wish to prepare for advanced social work practice in a variety of direct practice and community and social development settings, while developing the skills to assume management responsibility within those settings. Candidates must apply separately to each program.

MSSA/MBA students may begin the dual-degree in either Jack, Joseph and Morton Mandel School of Applied Social Sciences or Weatherhead School of Management. Students will continue to register in the school at which they began the program, regardless of the school they are attending. There are 102 credit hours in the dual MSSA/MBA Program (51 credit hours at MSASS, 51 credit hours at Weatherhead), compared with 124 credit hours if both degrees were completed separately. By integrating the course work, completing some course work over the summer, and reducing the elective requirements in each program, dual-degree students may complete the MSSA/MBA in three years, instead of the four years required if both degrees were to be completed separately. Dual-degree students must receive the MSSA and MBA degrees simultaneously to be granted credit for specific courses taken in the other program.

Master of Science in Social Administration and Bioethics (MSSA/MA)

A dual degree established by the Jack, Joseph and Morton Mandel School of Applied Social Sciences and the Department of Bioethics (http://www.case.edu/med/bioethics) in the university’s School of Medicine makes it possible for selected students to pursue an integrated program of studies to earn the Master of Science in Social Administration (MSSA) and the Master of Arts (MA) in Bioethics. In a full-time format both degrees may be earned in two years plus one summer semester.

As the number and complexity of ethical dilemmas continue to increase, there is a growing need for social workers knowledgeable of the principles and practices fundamental to bioethics. Graduates of this program may help counsel clients and care providers as well pursuing careers related to policy and practice.

Applicants must apply separately and meet the admission requirements of the both professional programs and are encouraged to apply simultaneously to both schools. Dual-degree students must receive the MSSA and MA degrees simultaneously to be granted credit for specific courses taken in the other program.

Master of Science in Social Administration and Public Health (MSSA/MPH)

The "Side by Side" Dual Degree Program leads to both the Masters of Science in Social Administration (MSSA) and the Masters in Public Health (MPH). The MSSA/MPH program will prepare graduates with flexibility for professional leadership in a broad range of health and social services within communities and organizations. Areas of study will include prevention, program planning, development and evaluation.

The impetus for this dual program arises from a growing societal recognition that issues once thought to represent individual-level interventions, such as family violence, substance use, and mental illness, are multi-level problems demanding multi-level interventions for their amelioration. The MSSA/MPH Degree Program will equip students with a broader set of skills and perspectives to address such issues.

This degree option is open to full-time students only due to the sequencing of courses. Applicants must apply separately and meet the admission requirement of the both professional programs and are encouraged to apply simultaneously to both schools. This dual degree can be completed in 36 months. Dual-degree students must receive the MSSA and MPH degrees simultaneously to be granted credit for specific courses taken in the other program.

Master of Science in Social Administration and Master of Nonprofit Organization (MSSA/MNO)

The dual degree in social work and non-profit organization offered by the Jack, Joseph and Morton Mandel School of Applied Social Sciences prepares students for leadership and management positions in human service organizations. Students may pursue either the Community Practice in Social Change concentration or the Direct...
Practice concentration. Further, this dual degree will place graduates into nonprofit management, administration, leadership, and research positions, which promises a great potential to influence the well-being of vulnerable groups and improve lives on a greater scale. MSSA/MNO dual degree students may apply for graduation in the term in which all requirements for the degree have been completed. It is not required that the MSSA and MNO be awarded simultaneously.

**Master of Nonprofit Organization and Law (MNO/JD)**

Being part of a world-class research university means you can combine your nonprofit management education with a Juris Doctor (JD) from Case Western Reserve University’s School of Law (http://law.case.edu). The MNO/JD program is 109 credit hours (JD 88 hours and MNO 39 hours, with 18 hours that double-count) and can be completed in four years. You must apply separately to and be admitted in each of the programs. Alumni with MNO/JD degrees are employed worldwide by leading organizations, including the Bill and Melinda Gates Foundation and the National Center for Transgender Equality.

**Undergraduate Minor in Social Work**

http://msass.case.edu/

Sharon Milligan, Associate Dean for Academic Affairs

sharon.milligan@case.edu

**Undergraduate Social Work Minor**

The Social Work Minor offers interdisciplinary collaborative learning that includes service, community engagement, and an exploration of values. Students experience active learning that is practical and applied to real-world settings. The minor integrates social work theory and practice, social policy, socio-behavioral theory and research to understand and address complex social problems of our time, domestically and internationally. Some issues covered in the courses include oppression and privilege, poverty, violence, social justice, alcohol and other drug abuse, social welfare, community development. Courses can be taken on campus or through the our short term international study and travel courses.

The Social Work minor requires 15 credit hours. Some of the courses include:

- SASS 284- Oppression and Privilege in a Multicultural Society
- SASS 315- Adoption Practice and Policy
- SASS 318- Death, Grief and Loss
- SASS 325- The Netherlands Social Justice: Health and Violence Prevention
- SASS 355- Drugs and Youth
- SASS 367- Poverty and Children
- SASS 369- Social Networking and Community Organizing in the 21st Century
- SASS 375A- Ecuador: Health, Human and Social Development in Ecuador
- SASS 375B- Mental Health Issues and Practice- The Netherlands
- SASS 375C- Poland: Invisible Groups in a New Poland
- SASS 375D- Guatemala: Community Development Approach to Child Welfare
- SASS 375F Gender and Sexuality Justice-LGBT life/ Dutch Culture
- SASS 385- Social Welfare Capstone
- SASS 390- Independent Study
- SASS 391- Seminar on Community Needs and Services

**Doctoral Program**

**Doctor of Philosophy in Social Welfare**

The purpose of the Doctor of Philosophy (PhD) in Social Welfare degree program is the preparation of scholars, teachers, and leaders to generate new knowledge on the policies and programs of social welfare and the practice of social work. Accordingly, we emphasize the creative and evaluative skills necessary for independent inquiry. The program prepares students to be knowledgeable in the following:

- Relevant areas of the social and behavioral sciences
- Research design, statistics, qualitative methods, mixed methods, and the philosophy of science
- Theory-building and theories of social welfare
- Methods for the application and transmission of knowledge in the human services

In addition to this foundation knowledge, students develop specialized expertise in policy analysis and program planning or social work practice theory and in one or more substantive areas of social welfare. Effort is made to provide an educational climate in which critical analysis and creative thinking flourish. The program core emphasizes philosophical and scientific approaches to theory development, the content and boundaries of theoretical social welfare, statistics, and advanced research methodologies, and the social and behavioral science foundations underpinning social welfare programs and social work practice.

The area of specialization enables the student to apply social science theory, analytical approaches, and research tools to a social problem or issue in either social welfare policy or social work practice. Students are encouraged to focus on a substantive policy or practice area during the period of specialization. This facilitates the development of a dissertation proposal. Permeating the content of the entire program is a focus on the development and transmission of knowledge as a part of an educational process.

To prepare students for academic careers in social work education is an integral part of the educational plan. Teaching mentorships are available.

Students can pursue special interests through individual reading and research projects. In addition, regular course offerings in other departments of the university are available to students. Practical experiences on faculty-conducted research projects are made available to doctoral students.

A total of 36 credit hours of course work is required, plus 18 hours of dissertation credit. A qualifying examination, given after completion of course work, determines each student’s eligibility for degree candidacy. The degree is awarded following successful completion of the dissertation.
The school reserves the right to require additional courses, which may not be credited toward the doctoral requirements, if the faculty believes the student has insufficient knowledge in core areas of the curriculum, or to assist students in their intellectual and professional development.

In response to the different needs and interests of potential PhD students, the Mandel School offers two formats for meeting course and degree requirements. Program requirements under both formats include taking 12 courses (36 credit hours), passing a qualifying exam, and completing a dissertation. The Alternative Program Structures are:

**Full-Time Program**
Under this format, full-time students can complete course requirements and individualized research fellowships over two academic years.

**Plan of Study: Full-Time Doctoral Program**

**First Year**

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<td>Theories of Human Behavior: Macro and Micro Dimensions (SASS 610)</td>
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<td>Advanced Research Design (SASS 613)</td>
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<td>Theories of Social Welfare and Social Justice (SASS 609)</td>
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<td>Models of Qualitative Research (SASS 614)</td>
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<td>Social Statistics and Data Analysis (SASS 615)</td>
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**Second Year**

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<td>Applied Regression and the Linear Model (SASS 616)</td>
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<tr>
<td>Individual Reading (SASS 637) (or course outside of MSASS) or Research Project (SASS 632)</td>
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<td>Seminar on Social Work Education (SASS 630)</td>
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<td>Measurement Issues in Quantitative Research (SASS 618)</td>
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<td>Specialization Seminar (SASS 617)</td>
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<td>Designing Mixed Methods Research (SASS 622)</td>
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<td>Individual Reading (SASS 637)</td>
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<tr>
<td>Research Project (SASS 632)</td>
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<td>Intervention Research for Social Work Practice (SASS 620)</td>
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**Third Year**

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<tr>
<td>Dissertation Ph.D. (SASS 701)</td>
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<td><strong>1-9</strong></td>
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</table>

**Total Units in Sequence:** **38-54**

Students must register each semester until the dissertation is complete. SASS 701 Dissertation Ph.D. hours are not required during the summer semester.

**Part-Time Program**
The part-time format accommodates social work professionals who must maintain their employment commitments but wish to pursue PhD study through the completion of a minimum of four courses per year.

**Faculty Advisors**
Each doctoral student is assigned a faculty advisor to assist in the planning of his or her educational experience. At the appropriate time, a dissertation advisor is appointed after consultation with the student.

**Qualifying Examination**
The qualifying examination for doctoral candidates is taken after completion of coursework. The exam is intended to test the student's ability to critically analyze and integrate knowledge.

**Admission to Candidacy**
Students are admitted to candidacy for the PhD degree upon the successful completion of the qualifying examination. To be admitted to candidacy, the candidate also must have maintained a grade point average of 3.0 and received not more than one course grade of C or lower. To remain in the program, students must maintain a minimum of a cumulative 3.0 average and receive no more than one grade of C or lower.

**Dissertation Requirements**
Each candidate for the PhD degree must submit a written dissertation as evidence of his or her ability to conduct independent research at an advanced level. The dissertation must present a significant contribution to knowledge in the student’s field, and at least a portion of the content must be suitable for publication in a reputable professional journal or as a book or monograph.

The dissertation prospectus must be completed and accepted within two calendar years after the student has been admitted to candidacy, and the dissertation must be completed and accepted within five calendar years after admission to candidacy. It is to the student’s advantage to make steady progress in his or her research and aim for early completion of the dissertation.

Once a student registers for SASS 701 Dissertation Ph.D., he or she must continue to register each succeeding regular semester (fall and spring) until the dissertation is complete unless granted a leave of absence. The minimum requirement for the dissertation is 18 hours.

All requirements for the PhD degree must be completed within a period of five consecutive calendar years after a student is admitted to candidacy, including periods of leaves of absence.

**Admission and Financial Aid**
Information about admission and financial aid for the PhD in Social Welfare (http://msass.case.edu/doctorate) can be found on the Jack, Joseph, and Morton Mandel School of Applied Social Sciences website.

**Academic Regulations**

**Non-Degree Study**
Foundation courses may be taken on a non-degree basis with the permission of the assistant dean for academic affairs. A maximum of 12 hours earned on a non-degree basis may be counted toward requirements.
Admissions and Application Information

Admission to the master’s degree program at the Jack, Joseph, and Morton Mandel School of Applied Social Sciences is granted on a selective basis determined by the quality of the total application. An applicant for admission is expected to meet the following minimum requirements:

1. A bachelor’s degree from an accredited college or university.
2. Evidence of capacity to succeed in graduate level education based on undergraduate work and any previous graduate work. Previous work must include courses strong enough to ensure the applicant’s ability to do creditable work at the graduate level.
3. A minimum undergraduate grade-point average is 2.7. A Miller Analogies Test or Graduate Record Exam is required for applicants with less than a 2.7 grade point average. In exceptional cases, applicants who lack the required academic credentials but whose other qualifications are outstanding may be admitted on a probationary basis. Students who enter on probation may not carry more than 15 credit hours in their first semester. Probationary students must achieve at least a 3.0 grade point average in their first semester of course work (minimum of six credits) to have their probationary status removed and continue in the program.
4. Evidence of a combination of personal qualities and values that are considered essential for the professional practice of social work and/or the non profit sector: strong moral character; strong analytical and verbal skills; a caring and compassionate nature; and a personal commitment to social justice, empowering individuals, and serving vulnerable and under-represented groups, communities and organizations.
5. The school may request a personal interview or additional information about an applicant if necessary.

Admission Procedures

Application materials for admission to the Jack, Joseph, and Morton Mandel School of Applied Social Sciences can be secured from the Office of Admissions, Jack, Joseph, and Morton Mandel School of Applied Social Sciences, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, Ohio 44106-7164 or by visiting the school’s website (http://msass.case.edu).

Students applying for full-time study in the social work program are admitted in the fall semester. Applications are accepted on a rolling admissions basis but the latest application date is April 15. The deadline for Intensive Weekend Program applications is June 1.

Students pursuing the MSSA in the online format are admitted in fall, spring, and summer semesters. Deadlines for completed applications are as follows: Spring semester: November 4; Summer semester: March 3; and Fall semester: June 30.

Students seeking admission to the Management of Nonprofit Organization (MNO) degree program are admitted in summer, fall and spring. Deadlines for completed applications for Summer semester: April 15; Fall semester: July 1; and Spring semester: November 15.

Although applications are accepted for all programs on a rolling admission basis, applicants are strongly encouraged to apply early.

Advanced Standing (Social Work Students Only)

Advanced standing may be granted to students who have earned a bachelor’s degree in social work within the past seven years from an institution accredited by the Council on Social Work Education. Students must have earned a grade of B or better in each social work generalist course for which advanced standing credit hours are given.

Proficiency Examinations (Non-BSW Social Work Students Only)

Students without a bachelor’s degree in social work may waive the generalist courses in policy, socio-behavioral theory, and research by passing a proficiency examination. Successful completion of the exam(s) exempts the student from the requirement to complete the course(s). Elective course(s) may be substituted in order to fulfill graduation requirements. There is no fee or penalty associated with taking the proficiency exams. However, each exam may be taken only once. Exams are offered up to fourteen(14) days prior to the start of fall and spring semesters. Students must make reservations to take those exams with the Mandel School Office of Student Services.

Transfer

Students who are transferring to the Mandel School from another accredited graduate school of social work may apply for transfer credit for up to one full year of academic work and field education. Transfer students from social work programs must submit field work evaluations, final official transcripts, course syllabi and the Request for Evaluation of Transfer Credit form.

Transfer credit (6 hour limit) may be given for related, but non-social work, coursework completed within the past seven years. Credit hours must not have been applied toward a previous graduate degree. Students must have received a grade of B or better in any course for which transfer credit is sought. Course syllabi, request for transfer form and official transcript must be submitted to the Mandel School Office of Admissions.

Courses approved for transfer credit are not used in computing the student’s GPA. Quarter hours will be converted to semester hours. No transfer credits can be granted for course(s) taken at international universities.

International Students

Applicants from other countries follow the regular application procedure. International students must have completed available social work training in their own countries, and have had paid experience in the social welfare or nonprofit field prior to entering the professional degree program. International students are required to furnish results of the Test of English as a Foreign Language (TOEFL) (http://www.ets.org/toefl) or the International English Language Test Service (IELTS) (http://ielts.org) administered by the Educational Testing Service. Results of this test must be forwarded to the Office of Admissions. A student from abroad whose native language is English, who has completed his or her work in a foreign university where English is the language of instruction, or who has studied at or graduated from an American institution, is exempt from this requirement. Federal requirements mandate that all international students on J-1 visas purchase the medical insurance. No exceptions are allowed. All other students are strongly urged to carry health insurance of some kind.

All international applicants must submit the university’s Office of International Students evidence of funding sources to fully finance the cost of education, housing, and transportation (approximately $13,000).
for one year. Living expenses for dependents, if applicable, must also be included, i.e. spouse $6,000 and child $3,000.

All international applicants must submit to the Case Western Reserve Office of International Students evidence of funding sources to fully finance the cost of education, housing, and transportation. Applicants from other countries will be sent an additional form requiring them to provide evidence of financial resources sufficient to cover their anticipated expenses before acceptance can be finalized. Students holding a BSW from their country of origin may be eligible for advanced standing. Applicants should contact International Social Work Degree Recognition and Evaluation Service, https://www.cswe.org/ Centers-Initiatives directly and ask to have their program reviewed.

An international applicant who holds a Master of Social Work (MSW) degree for his or her country may request a credit review for transfer credit. However, the student must complete at least 27 hours of academic credit and three semesters of field credit (9 hours) at the Mandel School. Please note that material submitted for application cannot be returned to the applicant.

Financial Information
Tuition
In the 2017-2018 academic year, tuition for the Jack, Joseph, and Morton Mandel School of Applied Social Sciences in the on campus master’s degree program (13-16 credit hours) is a flat rate of $43,500, or $1450, per credit hour (1-12 credit hours) in the Intensive Weekend and Online master’s degree program formats.

A non-refundable tuition deposit of $100 is required of all master’s degree candidates at the time of acceptance. This deposit will be applied toward tuition for the degree program. Complete information about academic policies, procedures, and financial aid is available by contacting the Office of Admissions, Jack, Joseph, and Morton Mandel School of Applied Social Sciences at 216-368-1655.

Academic Standing and Academic Difficulty
PROBATION AND DISMISSAL POLICIES
Probation Based on Academic Performance
A student who receives a grade point average below 3.0 in any semester or cumulative will be placed on probation. A student on probation must obtain at least a 3.0 average in the subsequent semester in order to be removed from probation. Since probationary status may have financial aid implications, students on probation are directed to contact the financial aid office upon determination of probationary status.

Dismissal Based on Academic Performance
A student will not be permitted to continue in the program if he, she or they receives:

1. A second grade of F in the program, or two semesters of No Pass (NP) in field education or No Pass (NP) in any course;
2. A grade point average (GPA) of 2.0 or below in any one semester or cumulative;
3. A grade point average (GPA) less than 2.8 entering the final semester;
4. If a student admitted on academic probation does not earn a 3.0 GPA in the first semester; If a student admitted on academic probation earns NP in field at any time, the student will be academically dismissed.
5. For part-time, Intensive Weekend, and online students, these policies apply in two semester blocks of time.

A NO PASS (NP) counts as F for purposes of determining academic standing.

STUDENTS COMPLETING WORK BEYOND THE END OF A SEMESTER may be subject to academic actions at any point within the next semester. Students will be academically withdrawn from their courses and their records updated based on academic decision.

Student will be fully responsible for all financial obligations up to the date of academic action.

University Registrar requires letters of academic standing indicating probation or dismissal be sent to the student at the address on file in the Student Information System (SIS). Letters of dismissal are sent by certified mail and electronically by E-LETTER. Letters of probation are sent regular first-class mail delivery and electronically by E-LETTER.

INCOMPLETES IN ACADEMIC COURSES
1. A grade of Incomplete is given at the end of the semester only when a student has discussed the matter with his/her/their instructor and there are extenuating circumstances that clearly justify an extension beyond the requirements established for the other students in the class.

1. The student and the instructor must agree on a due date for fulfilling the requirements for the Incomplete. A signed “Request for an Incomplete Grade” (by both the instructor and student) must then be submitted to the Mandel School Registrar by the instructor. This form can also be printed from the Mandel School Registrar's website at http://msass.case.edu/registrar. The form must be specific in what assignment(s) are due and the date(s) by which assignment(s) must be submitted. For administrative purposes, instructors must submit final grades for Incomplete as soon as coursework is submitted and graded.

1. If a student fails to remove the incomplete within the specified time, he/ she/they forfeits the privilege of completing the course for credit and the instructor must assign a grade of F. For exceptional situations in which there are extenuating circumstances, the student and advisor may request, in writing, an extension beyond one semester from the Assistant or Associate Dean for Academic Affairs, with the instructor's approval.

1. If a student accumulates three or more grades of “Incomplete,” he/ she/they may not enroll in the subsequent course or term and will be considered to be "on probationary suspension" from the program. This policy includes grades of “Incomplete” in Field Education. These students will be required to clear all but one grade of “Incomplete” on their records before they will be allowed to re-enroll in School.
**INCOMPLETE IN FIELD EDUCATION**

An Incomplete for fieldwork should be treated in the same manner as an Incomplete in academic courses. An Incomplete is only appropriate when insufficient hours were spent in placement, or assignments were not finished for reasons of illness or other excused absences. An Incomplete is also used for field education when the student is assessed to be performing at the marginal level and a remediation plan is required to be completed prior to a determination being made as to whether the student receives a P or an NP for the field period. A grade of Incomplete must be removed before entering the subsequent semester of field work.

**LATE ASSIGNMENTS**

**Assignments are due on the date assigned.** Exceptions must be cleared in advance with the instructor. In the absence of a mutual agreement by the student and instructor, the instructor is not obligated to accept papers and a grade of "F" can be entered for the assignment. If the instructor determines justifiable circumstances, additional time may be granted.

**COURSE REPEAT POLICY**

Students may repeat a maximum of two courses during their degree program in order to improve their performance. A course can only be repeated once. When a course is repeated the first and second course grades appear on the transcript, and the two grades are included in the calculation of the cumulative grade point average and the grade point average for the semester in which it was earned, regardless of whether the new grade is higher or lower than the first grade.

The course repetition may be exercised according to the following conditions:

1) The course repeat option can only be used on courses in which a C or lower was earned. Courses with a grading basis of P/NP are not eligible under this policy.

2) A student may not use the Pass/No Pass option on a course that is being repeated.

3) A student may only use the repeat option on the same course.

4) The course repeat option may not be exercised after a degree has been awarded.

5) Approval of the academic adviser and the Associate Dean for Academic Affairs or designee.

6) An academic action including but not limited to dismissal or probation that occurred under the earlier grade is neither reversed nor removed from the record as a result of a change in the semester or cumulative averages that result from the repetition of one or two courses.

7) All grades earned at Case Western Reserve University will be applied to the scholarship GPA that is reviewed in order to determine scholarship funds. Scholarship funds must not be utilized to repeat a course.

8) The tuition and associated fees for a repeated course is the responsibility of the student. Scholarship funds must not be utilized to repeat a course.

**READMISSION TO CANDIDACY**

A student who leaves the Mandel School in good standing without completing requirements for the degree may re-enter within a three-year period and receive credit for previous work. Any former student who wishes to complete degree requirements and who has been out of school for three years or more must reapply for admission. All information regularly required for an admission application must be updated. The application will be reviewed in light of current admission policies.

Upon acceptance for readmission, the specific courses and field work required for completion of the student's program will be determined in accordance with current degree requirements. Credit hours will not be granted for work completed more than five years before readmission.

If a student is terminated due to inadequate academic performance, he/she/they may request reinstatement although this will not be considered until two semesters after termination. A written petition must be forwarded by the student to the Chair of the Committee on Students who will present the petition for possible review by the full Committee at the next scheduled meeting. The Committee meets monthly except in June, July, and August. In all cases, the student must remain separated from the School for a minimum of two semesters (fall, spring, and summer are considered semesters).

The petition must include the following: a) the student’s reason for requesting the reinstatement, b) an identification of the circumstances that led to the termination, and evidence of personal, educational, or professional activities or accomplishments that would demonstrate the student’s readiness to return to school and successfully complete the degree program. The Committee will meet with the student, if desired, and thereafter recommend to the Associate Dean of Academic Affairs one of three possible responses: 1) readmit, 2) readmit with condition, or 3) do not readmit.

**Special Focus and Certificate Programs**

**Certificate Programs**

**Global Health**

The Certificate in Global Health (http://www.case.edu/orgs/cghd/training/certificate.htm) focuses on the broadest concept of public health, including international aspects of disease transmission, diagnosis, treatment, policy, and prevention. The overall objective of this interdisciplinary certificate is to support MSASS students with interests in health problems, issues, and concerns that (a) transcend national boundaries, (b) may be influenced by circumstances or experiences in other countries, and (c) are best addressed by cooperative actions and solutions. Current participating departments and schools at Case Western Reserve University include Mathematics, Medicine, Public Health, Anthropology, Nursing, Bioethics, Epidemiology, Biostatistics, Biology, and Engineering.

The requirements to receive the certificate differ by discipline and emphasize discipline-specific and interdisciplinary coursework.

For MSASS students, this includes completion of two required interdisciplinary courses and an additional MSASS elective. The certificate is most appropriate for students who choose to complete the Community and Social Development program, or the Health or Aging specializations in the Direct Practice program.

**Gerontology**

Students with an interest in serving the needs of the aging population may pursue the multidisciplinary graduate certificate program offered through the Case Western Reserve University Center on Aging and Health (https://nursing.case.edu/ucah). This program is designed for gerontological researchers, educators, and practitioners. Participating
School Social Work
The School Social Work program is designed to train school social workers and provide them with the competencies to practice in a variety of traditional and non-traditional primary and secondary education settings. Such competencies include assessing children's needs; designing and implementing interventions; and making referrals to other professionals and agencies, as needed. School social workers function collaboratively with educators and other professionals to assist the schools and the communities in mobilizing resources on behalf of children and adolescents, in order to help ensure academic success.

The program is consistent with the Ohio Department of Education, State of Ohio, regulations and professional standards developed by the National Association of Social Workers, and is a jointly offered by the Mandel School of Applied Social Sciences at Case Western Reserve University and the Division of Education at Baldwin-Wallace University. Students in the program complete the Master of Science in Social Administration (MSSA) degree at the Mandel School with a specialization in Children, Youth and Families. As part of the MSSA degree, students complete three required education courses at Baldwin-Wallace University, SASS 519 Children and Families in the School Setting, and a field practicum in an approved school social work setting. After the completion of all required coursework and field education, a student can apply to the State of Ohio Department of Education to receive a certificate in school social work.

This program can be completed only by two-year and eighteen-month students (not twelve-month students). Intensive weekend students can also complete this program if they are able to enroll in some full-time program courses.

Management and Leadership
This certificate allows students to pursue a set of focused coursework designed to prepare them for managing and leading in a range of social welfare settings. The certificate is available to all MSSA students regardless of concentration or specialization and can be completed within the normal masters framework. To do so, students forgo taking concentration-related electives and instead undertake the fifteen (15) academic credit courses required for the certificate. These courses include an introduction to management and leadership, supervision, budgeting and finance, and program design. In addition, students select one elective based on their interests from a set of approved courses.

Nonprofit Management
This certificate is offered as a credential requiring 15 academic credit hours. The certificate may be done concurrently with the MNO degree, MSSA degree or may be taken as a stand alone credential. The requirements are four 3-hour courses from the approved listing for the Master of Nonprofit Organization and a 3-hour nonprofit dialogues course.

Special Focus Programs
Louis B. Stokes Fellowship in Community and Social Development
The Louis Stokes Fellows Program in Community and Social Development provides a full tuition scholarship to African American and Hispanic/Latino students with an interest in Community Practice for Social Change. The goal of the Louis Stokes Fellows program is to:

- Support the graduate professional education of outstanding students from universities with Hispanic students and students from traditionally Black colleges and universities.
- Attract a greater number of African American and Hispanic students to advanced social work education to help meet the need for diversity in the social work profession.
- Foster future leadership in community building, community development, and housing.

Child Welfare Fellowship
The primary goal of the Child Welfare Fellows program is to improve the public child welfare workforce in Northeast Ohio. Emphasis is placed on using evidence-based best practices in public child welfare and systems of care principles. The Mandel School's Intensive Weekend program makes it possible for employed individuals in public child welfare agencies in Northeast Ohio to overcome barriers of time and finances to pursue a Master's degree in social work.

Leadership Fellowship Program
The Leadership Fellows Program focuses on exceptional students who want to assume leadership in clinical practice within an agency context. It is a two-year program of study for direct practice students in aging, alcohol and other drugs, children, youth and families, health or mental health.

Paul D. Coverdell Fellowship Program for Returning Peace Corps Volunteers
The Paul D. Coverdell Fellowship Program for Returning Peace Corps Volunteers provides the option for students selecting concentrations in Community Practice for Social Change or Direct Practice. The Direct Practice concentration will allow students to select specializations in aging; alcohol and other drug abuse; children, youth and families; health; and mental health with children, adolescents and adults. Fellows will be able to integrate professional social work education, research and service to promote social justice and community empowerment domestically and around the world. Students also have the option of pursuing certificates and dual degrees in several interest areas.

Global Practice Opportunities
At the Mandel School, students have numerous opportunities to explore beyond our own borders. The Mandel School faculty includes experts in international social work and social policy research. The Mandel School also hosts numerous international full-time students, exchange students, visiting scholars and researchers.

Qualified students may choose to participate in a number of multi-disciplinary study abroad opportunities. Many trips occur during winter and spring break and the beginning of summer semester. Students are able to familiarize themselves with a variety of social policies of other countries, which have included the Netherlands, Guatemala, Ecuador, India, Poland, Ghana, and Israel, among others.
Jack, Joseph, and Morton Mandel School of Applied Social Sciences Faculty

Department Faculty

Sarah S. Andrews, MSSA  
(Case Western Reserve University)  
Senior Instructor, Social Work; Director, School Social Work Program  
Family development, death, loss & bereavement, women's issues

Barbara Anthony, PhD  
(Georgia State University)  
Research Assistant Professor, Social Work  
Community psychology, effects of poverty on early childhood development

Mark P. Aulisio, PhD  
(Bowling Green State University)  
Associate Professor, Bioethics and Social Work; Director, MA Program in Bioethics; Director, Center for Biomedical Ethics, MetroHealth  
Intersection of political philosophy and bioethics, consultation

David E. Biegel, PhD  
(University of Maryland)  
Henry L. Zucker Professor of Social Work Practice; Chair, Doctoral Program; Co-Director, Center on Substance Abuse and Mental Illness: Professor of Psychiatry (Secondary Appointment); Professor of Sociology (Secondary Appointment)  
Mental health, informal support systems, aging, caregiving

Merri Elizabeth Brindo, MSSA  
(Case Western Reserve University)  
Clinical Instructor, Social Work; Field Faculty Advisor  
Child welfare

Mark G. Chupp, PhD  
(Case Western Reserve University)  
Assistant Professor, Social Work: Director of International Education Programs  
Inter-group dialogue and conflict transformation, citizen participation, community building, community organizing, appreciative inquiry, service learning

Rashonda Clay-Douthit, MSW  
(University of Maryland)  
Clinical Instructor, Online Field Education Faculty Advisor  
Social work methods, social welfare

Claudia J. Coulton, PhD  
(Case Western Reserve University)  
Lillian F. Harris Professor of Urban Research and Social Change; Co-Director, Center on Urban Poverty and Community Development  
Research in urban poverty, neighborhoods, community development

David Crampton, PhD  
(University of Michigan)  
Associate Professor, Social Work  
Child welfare, community and social development, program evaluation

Marjorie Edguer, MSSA  
(Case Western Reserve University)  
Assistant Professor, Social Work  
Resilience in children and youth, immigrant youth, trauma and loss, high risk youth

Kathleen J. Farkas, PhD  
(Case Western Reserve University)  
Associate Professor, Social Work  
Co-occurring substance abuse and mental disorders, jail/prison-based treatment, women/elderly substance abuse assessment and treatment

Robert L. Fischer, PhD  
(Vanderbilt University)  
Associate Professor of Research, Social Work; Co-Director, Center for Urban Poverty and Community Development; Director, Master of Nonprofit Organizations Degree Program  
Program evaluation, social/behavioral intervention research, child/family interventions, nonprofit programming, policy studies

Daniel J. Flannery, PhD  
(The Ohio State University)  
Semi J. and Ruth Begun Professor in Violence Research Prevention and Education; Director, Begun Center for Violence Prevention Research and Education  
Violence prevention, mental health, program evaluation

Adrianne Fletcher, PhD  
(Loyola University)  
Assistant Professor  
Disproportionality in child welfare system and across social institutions, implicit association/bias, issues of diversity, social welfare policy, social justice and advocacy, child welfare and Indian child welfare

Darcy A. Freedman, PhD  
(Vanderbilt University)  
Associate Professor, Epidemiology and Biostatistics  
Food access interventions, health equity, public health literacy, qualitative methods, primary prevention of chronic disease

Kathi L. Overmier Gant, MSSA  
(Case Western Reserve University)  
Clinical Instructor, Social Work; Field Faculty Advisor  
Direct practice, adult and adolescent mental health, assessment and diagnosis, criminal justice

Stephanie Gilman, MSW  
(Columbia University)  
Clinical Instructor, Social Work, Field Faculty Advisor  
Field Education

Grover C. Gilmore, PhD  
(Johns Hopkins University)  
Jack, Joseph and Morton Mandel Dean in Applied Social Sciences; Professor, Social Work and Psychology  
Visual perception and aging, Alzheimer's disease, intelligence
Brian K. Gran, PhD
(Northwestern University)
Associate Professor, Sociology
Children's rights and social policy

Victor K. Groza, PhD
(University of Oklahoma)
Grace G. Brody Professor of Parent-Child Studies
Child welfare workforce and systems, older child and sibling group adoptions, intercountry adoption, international child welfare

Timothy F. Hagan, Honorary Doctor of Law
(Cleveland State University)
Distinguished Visiting Faculty for Public Policy
Politics and policy, children's issues

Megan Holmes, PhD
(University of California, Los Angeles)
Assistant Professor, Social Work
Domestic violence, alcohol use and child maltreatment, research

David Hussey, PhD
(Case Western Reserve University)
Associate Professor, Social Work
Substance abuse, violence, social and behavioral science, psychopathology

Deborah Regenbogen Jacobson, PhD
(Tulane University)
Assistant Professor, Social Work
International education and administration, practice evaluation

Jeffrey Janata, PhD
(Case Western Reserve University)
Associate Professor, Psychiatry UH
Behavioral Medicine, Health Psychology, Obsessive-Compulsive Spectrum Disorders, Pain Disorders, Outcomes Measurement

Mark L. Joseph, PhD
(University of Chicago)
Associate Professor, Social Work
Urban poverty, community development, mixed-income development, comprehensive community initiatives

Eva Kahana, PhD
(University of Chicago)
Pierce T. & Elizabeth D. Robson Professor of Humanities; Professor, Social Work; Director, Elderly Care Research Center
Sociology of aging, medical sociology, social factors in stress and coping

Jennifer King, DSW
(University of Pennsylvania)
Assistant Professor, Social Work
Clinical social work, trauma-informed care, childhood trauma

Jill E. Korbin, PhD
(University of California, Los Angeles)
Professor, Anthropology and Social Work; Director, Schubert Center for Child Studies; Co-Director, Childhood Studies Interdisciplinary Program; Associate Dean, College of Arts and Sciences
Culture and human development, child well-being and child maltreatment, cultural, medical and psychological anthropology

Siran M. Koroukian, PhD
(Case Western Reserve University)
Associate Professor, Social Work; Associate Professor, Epidemiology and Biostatistics
Methodological issues in the use of large databases in health services research, Medicare and Medicaid programs, cancer-related and other health disparities

Amy Korsch-Williams, MSSA
(Case Western Reserve University)
Instructor, Social Work; Director of Field Education
Field Education

Jeff M. Kretschmar, PhD
(Miami University of Florida)
Assistant Professor of Research, Social Work
Violence and aggression, suicide, victimization, mental health and substance abuse

Sana Loue, PhD
(University of Southern California at Los Angeles and Case Western Reserve University)
Professor, Department of Epidemiology and Biostatistics; Director for Minority Public Health, School of Medicine
Immigration law and health, impact of HIV on the family, HIV in underserved populations, ethics in research, public health and law

Gerald J. Mahoney, PhD
(Vanderbilt University)
Verna Houck Motto Professor of Families and Communities; Director, Center on Interventions for Children and Families
Early childhood mental health, early intervention, parent education, disabilities

Kimberly McFarlin, MSSA, MNO
(Case Western Reserve University)
Clinical Instructor, Social Work
Field Education, International Social Work

David B. Miller, PhD
(University of Pittsburgh)
Associate Professor, Social Work
African American fatherhood, violence as a public health problem, child maltreatment, adolescent resiliency factors, treatment of individuals exposed to violence

Sharon E. Milligan, PhD
(University of Pittsburgh)
Associate Dean for Academic Affairs; Chair, Master’s Program; Associate Professor, Social Work; Associate Director, Center on Urban Poverty and Community Development
Evaluation of community-based initiatives, community and social development practice and urban poverty research

Meeyoung Oh Min, PhD
(Case Western Reserve University)
Research Assistant Professor, Social Work
Substance-using mothers and their children, childhood trauma and its correlates/consequences, research methods and statistics
Sonia Minnes, PhD  
(Case Western Reserve University)  
Associate Professor, Social Work  
Behavioral and mental health outcomes of prenatally drug-exposed children

Diana Morris, PhD  
(Case Western Reserve University)  
Florence Cellar Associate Professor of Gerontological Nursing; Executive Director, Case Western Reserve University Center on Aging and Health  
Geriatric mental health, aging and quality of life, family care giving, science of unitary human beings

Malika Hook Muhammed, MSW  
(Columbia University)  
Clinical Instructor, Social Work; Field Faculty Advisor  
Field Education

Cristina Nedelcu, MSSA  
(Case Western Reserve University)  
Lecturer, Social Work  
Child welfare, immigration & adoption, child and adolescent development, trauma survivors, child and adolescent mental health

Nancy V. Neuer, MSSA  
(Case Western Reserve University)  
Clinical Instructor, Social Work, Field Faculty Advisor  
Clinical social work, health

Ann Nguyen, PhD  
(University of Michigan)  
Assistant Professor, Social Work  
Gerontology, mental health disparities, informal social support, social networks, subjective wellbeing, African American, Afro-Carribean, religion

G. Regina Nixon, PhD  
(Howard University)  
Instructor, Social Work  
Poverty/high-risk populations, cultural diversity

Lori Longs Painter, MSSA  
(Case Western Reserve University)  
Clinical Instructor, Social Work, Field Faculty Advisor  
Social work practice

Andrea Goodloe Porter, MSSA  
(Case Western Reserve University)  
Clinical Instructor, Social Work; Assistant Dean, Student Services; Director, Student Services  
Child abuse and child welfare, domestic violence, sexual abuse identification, investigation and treatment, crisis intervention

Dana Prince, PhD  
(University of Washington)  
Assistant Professor, Social Work  
Impact of cumulative disadvantage on youth development trajectories, risk behavior and health outcomes, intersectionality of race, class, gender and youth health disparities, youth transitions, school and community-based prevention, program development and evaluation

Christina M. Delos Reyes, MD  
(Northeastern Ohio Universities College of Medicine)  
Associate Professor of Psychiatry; Associate Professor Social Work; Addiction Psychiatry Fellowship, University Hospitals Case Medical Center, Chief Quality Officer  
Substance abuse, mental health

Francisca Richter, PhD  
(Oklahoma State University)  
Research Assistant Professor, Social Work  
Economic behavior

Richard Romaniuk, PhD  
(Polish Academy of Sciences, Warsaw Poland)  
Lecturer, Social Work  
Neuroscience, immigration

LaShon Sawyer, PhD  
(Case Western Reserve University)  
Director of Online Education, Clinical Instructor, Social Work; Interim Director of Field Education  
Mental health, juvenile justice

Mark I. Singer, PhD  
(Case Western Reserve University)  
Leonard W. Mayo Professor in Family and Child Welfare; Co-Director, Center on Substance Abuse and Mental Illness; Deputy Director, Begun Center for Violence Prevention Research and Education  
Adolescent mental health, adolescent substance abuse, youth-related violence

Susan Snyder, MSW  
(New York University)  
Clinical Instructor, Social Work; Field Faculty Advisor  
Field education, clinical social work practice

Sree N. Sreenath, PhD  
(University of Maryland, College Park)  
Professor, Electrical Engineering and Computer Science, Director of Case Complex Systems Biology Center  
Sustainable development, population behavior, modeling and control of multibody systems

Gerald Strom, MSW  
(Howard University)  
Senior Instructor, Social Work; Director, Intensive Weekend Program  
Child abuse, growth and development, sex abuse investigation and treatment, clinical practice

Sheriina Thomas, PhD  
(Walden University)  
Clinical Instructor, Social Work, Online Field Faculty Advisor  
Youth advocacy, Minority education
SASS 284. Oppression and Privilege in a Multicultural Society. 3 Units.
Privilege flings open the doors of opportunity in a multicultural society. Oppression jams those doors tightly shut. This course provides students with understandings of how oppression and privilege operate in a multicultural society to restrict the life chances of minority and disenfranchised group members. Increasing knowledge about the nature and dynamics of oppression and privilege are fundamental dimensions of the ability to value a diverse world. This undertaking requires self-assessment and reflection on discrimination, oppression, and privilege as components of individual awareness. Such insight will help students to live, work, study, and play well with "others" who are culturally different from themselves with respect to race/ethnicity, religion, class, gender, sexual orientation/gender identity, ability, and age. Beyond increasing respectful social interaction, it is hoped that students will be motivated to work towards dismantling systems that perpetuate de-valuing, exploitation, marginalization, and violence against members of subordinate groups. Major consideration will be given to structures of oppression and privilege related to racism, classism, religious bigotry, sexism, heterosexism/transgenderism, ableism, and ageism. Note: A student cannot receive degree credit for both SASS 284 and SOCI 349.

SASS 315. Adoption Practice and Policy. 3 Units.
This course covers the concepts, knowledge, skills, and policies associated with contemporary adoption practice. The practice method reflects a constellation perspective, meaning that adoption is examined from the viewpoints of birth families, adoptees, and adoptive families. Exemplars and case studies are presented for illustration purposes. Consideration of constellation members’ needs at different life cycle stages are presented. Ethical issues and dilemmas related to adoption are emphasized throughout the course in each content area. Course content is covered via lectures and classroom discussions, as well as appropriate guest speakers. Students are expected to participate fully through field trips and classroom discussions.
SASS 318. Death, Grief, and Loss. 3 Units.
This course provides students the opportunity to become informed, aware citizens understanding human issues related to end-of-life decision making, dying, and experiencing grief and loss. Topics focus on death and grief across the lifespan; the role of death in American culture; understanding individual and family challenges with decision making at the end of life; and the experience of grieving across life stages, cultures, gender, and spiritual difference. The course provides exposure to the experience of death as it relates to the self of the student; the terminally ill person, and the bereaved. Students will gain insight into their own values and beliefs in this area, as well as understanding the needs of terminally ill people, those who need support in their grief and mourning, and persons dealing with challenging life and death decisions regarding self or loved ones. Creation of a personal learning objective is an additional focus. Course content is implemented via lectures, class discussion, individual and small group work, audio-visuals, and guest speakers.

SASS 325. The Netherlands Social Justice: Health and Violence. 3 Units.
Social justice issues including violence prevention and health care services/policies will be explored via agency visits, lectures, and discussion with Dutch experts. The pervasive use of a harm reduction policy in the Netherlands will be examined. The course will help students develop the analytical skills necessary for evaluating social policy and practice issues related to a range of health care services as well as social justice issues that pertain to health care, prostitution and substance use. Students will familiarize themselves with the United States and Dutch social policies and practices related to issues such as: right to die, euthanasia for terminally ill, those in chronic pain or severely ill newborns; access to healthcare and health disparities; addictions; and prostitution. The manner in which a society treats its citizens least capable of taking care of themselves reveals many of the core values of its cultural system of social justice and approaches to health care. Counts for CAS Global & Cultural Diversity Requirement.

SASS 330. Seminars in Applied Social Sciences. 3 Units.
Survey of special subject areas. Topics vary in response to faculty and student interests. Small group discussion. Prerequisite depends on content.

SASS 355. Drugs and Youth. 3 Units.
Drug abuse is a more acute problem and more widespread than in any previous era of our country. Just as technology continues to evolve, drug use follows similar paths of evolution. Today, there are thousands of new drugs available that are used for medicinal purposes, recreational purposes, and other uses that affect the health of our citizens. The impact of drug use and/or abuse on the lives of ordinary people will be explored both through academic readings as well as biographies of young people who have dealt with the problem of drug abuse. Material will be presented from a wide range of disciplines and theoretical perspectives highlighting the bio-psycho-social nature of the problem—both the etiology as well as the effects of addiction. The impact of both macro (society) and micro (family and friends) on drug use of both licit (alcohol, over the counter drugs, and prescription) and illicit (marijuana, hallucinogens, and cocaine) on various subcultures such as sports/athletics, college students, women, adolescents, etc. will be explored. Course content will be covered via lectures, classroom discussions as well as appropriate guest speakers.

SASS 367. Poverty, Wealth Building, and Social Entrepreneurship. 3 Units.
With poor communities and individuals across the world aspiring for higher standards of living and quality of life, monolithic development strategies are proving to be insufficient. Microenterprise and social entrepreneurship are among the latest strategies for poverty alleviation. New strategies that are grass-roots, multi-dimensional, entrepreneurial, and engage stakeholders as partners are gaining ground. They seek to fundamentally transform the roles and relationships of the stakeholders in the economy. While social entrepreneurship is revolutionizing the practice of development work, the micro-enterprise sector plays an important role for some of the poorest sectors of society who gain employment, connection to the market, and opportunities for innovation through it. In this course, we will examine social entrepreneurship, the change it brought about in how development is viewed, conceived, and implemented. Some of the examples that will provide core content include economic development strategies that promote asset building among the poor; Mandragon in Spain (and other similar institutions from across the world), Greyston Bakery (and other similar examples from around the United States) and Evergreen Cooperative (and other relevant local examples).

SASS 368. Whatever it Takes: Creating Paths Out of Poverty for Children. 3 Units.
This course will examine current community based strategies for providing young people living in high poverty, multiple needs, urban areas with the educational, social and economic support they need for a stronger future. The course will begin with a review of the debated root causes of poverty in the United States and an exploration of the short and long term effects of poverty on children. Students will understand how poverty differentially affects different populations and geographic areas across the United States and globally. Special attention will be given to the complexity of urban poverty issues and the corresponding need for holistic Interventions. The course will further explore the concepts and strategies underlying innovative community-based initiatives being implemented across the country including the theories, programming content, inclusion criteria and outcomes of these efforts. Students will have to critically think through the cost/benefits of this programming considering economic, political and social justice issues. Special attention will be given to the Harlem Children Zone’s (HCZ) model. The HCZ has achieved successes in boosting college attendance and closing the racial and socioeconomic achievement gap among youth in a high-poverty target area in New York City. The HCZ is the model for the Obama Administration’s Promise Neighborhoods Initiative to support comprehensive neighborhood development programs for children and youth. It includes efforts for social, educational and medical support designed sequentially to keep up with youth’s developmental needs. Students will critically analyze this model and its applicability across other geographic areas and populations. Students will also learn from local best practice Initiatives in education attempting to provide a path out of poverty for Cleveland’s children through site visits at local schools. This will include experiential opportunities for firsthand contact with program staff and youth.
SASS 369. Social Networking and Community Organizing in the 21st Century. 3 Units.
This course will examine the changing nature of place, given increased mobility and diversity in communities within the United States and the emergence of a truly global economy and communication network due to the revolution in information technology. Community itself is being redefined as many members of society consider their most important relationships are primarily virtual in nature. The forms of engaging citizens are also changing as old models of community organizing give way to new approaches that focus on connectivity through social networks. This course will examine various new approaches to engagement, from political or campaign organizing to social networking around mutual interest to mobilizing people for a cause. We will examine the Obama presidential campaign as an example of a new mobilization strategy that emphasizes choice, flexibility, value, and the ability to influence through organic informal networks. The course will also explore case studies, such as network centric organizing as developed by Bill Traynor and Lawrence (MA) Community Works. Special attention will be given to controversial efforts criticized by the right or the left, such as the ACORN voter registration initiative. Students will also explore the changing nature of community in Northeast Ohio and how this new approach might lead to social change and economic development for greater Cleveland.

SASS 375. International Travel and Study Seminar. 3 Units.
The course provides an intensive experiential learning experience that take students to a Non-Western European country for appropriately 10-12 days to explore social and community development issues, policies and practices. There will be at least 42 hours of contact time with the instructors in Cleveland and the Non-Western European country. The program explores innovative approaches to social development and draws parallels to that of the United States. The purpose of the trip is to familiarize students with social development and social policy issues. Topics appropriate to the targeted country, such as poverty alleviation, non-formal education, prostitution, HIV-AIDS, multicultural aspects of healthcare, international adoption, and possible application of information communication technologies in addressing social problems will be addressed. The trip will include guided tours to neighborhoods, field-action project workers, healthcare professionals, government officials, scholars, and researchers will further enhance students’ understanding. Students are required to attend a minimum of two pre-trip seminars, write and/or present pre-trip assignment(s), attend a post-trip meeting, and complete a final written assignment. The course requires an additional cost for travel.

SASS 375A. International Travel & Study Abroad: Health, Human and Social Development in Urban & Rural Ecuador. 3 Units.
The study abroad program to Quito, Ecuador and surrounding rural areas will acquaint students with the history and culture of Ecuador, its social, political and economic development, and the impact it has on the delivery of social services. Ecuador’s historical and current relationship with the United States will also be explored. This course is designed for students and professionals who are interested in developing an international perspective for the study of social work and related health services. It will expose students to helping modalities within a cultural context and provide opportunities for cross cultural comparison. The course will be taught using both lecture and experiential modalities. Along with interaction with a variety of social service agencies, students will visit historical sites and attend cultural events. They will be introduced to the art and culture of the area and explore the region’s economic development. Lectures by guest speakers on topics regarding family systems, culture, and history, social and political issues will provide students with learning opportunities. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375B. International Travel & Study Abroad: Mental Health Issues & Practice Netherlands. 3 Units.
This 3-credit course will be at least 42 hours of contact time, and include a trip to the Netherlands over Spring Break. The course will acquaint the participant (undergraduate and graduate) with the socio-political factors that influence policy development and the delivery of mental health care and services to the citizens of the Netherlands. The role of the social work profession in mental health care and service delivery will be explored via agency visits, lectures, and discussion with Dutch consumers and experts in the area of mental healthcare. This course will help students develop the analytical skills necessary for evaluating social policy and practice issues related to mental health. Students will familiarize themselves with the United States and Dutch social policies and practices related to specific mental health issues such as: treatment of severe mental illness, community mental health systems and community reintegration of the those with mental illness, psychosocial rehabilitation, the treatment of people with dual diagnoses of substance dependence and abuse and mental illness, homelessness and the mentally ill, psychiatric hospitalization, employment, education and issues of quality of life for people living with mental illness. Prior to the trip, students will attend a pre-trip session, will be expected to become familiar with the literature on concepts in social policy and practices relevant to mental health issues in both countries, and following the trip, meet for a post-trip session. Counts for CAS Global & Cultural Diversity Requirement.
SASS 375C. International Travel & Study Abroad: Invisible Groups in a New Poland. 3 Units.
This 3 hour Spring Break for the undergraduate and graduate students introduces students and faculty to Polish culture and Polish social policies and practices concerning those social groups that are disenfranchised, stigmatized, and disempowered, including the poor, the unemployed, the homeless, the elderly, victims of domestic violence, and people affected by substance abuse and mental health problems. In cooperation with the Institute of Sociology at the University of Poznan, students and faculty will examine the issues of multiculturalism, social integration, feminism studies, and determinants of social exclusion in the context of the economic and social forces that are shaping a new Poland. The trip includes guided tours of neighborhoods and social institutions and daily lectures and workshops with government officials, practicing social workers, and many of Poland’s most prominent scholars in residence at the University of Poznan. The experience will challenge students to recognize how the recent political and economic transformation of the country has affected the entire society and how certain groups have paid a higher price. Students and faculty will also participate in cultural events to gain a greater understanding of Polish society. Prior to the trip, students will attend two pre-trip sessions, will be expected to become familiar with the literature on concepts in social policy and practices relevant to social welfare issues in both countries, and following the trip, meet for a post trip session. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375D. International Travel & Study Abroad: Child Welfare in Guatemala. 3 Units.
This program is designed to familiarize participants with child welfare issues, social services, and indigenous community development, particularly women cooperatives. The plan is for participants to learn Spanish each morning, followed by guided tours of various programs. The experience challenges participants to compare Guatemala with the United States, and to understand the strengths and weaknesses of social policies and human services in both countries. This course acquaints participants with the socio-political factors that influence the development of child welfare programs in the nongovernmental sector (private, nonprofit) and governmental sector in Guatemala. The role of the helping professions in child welfare are explored via agency visits, lectures, and collaboration with Guatemalan professionals. The program is an intense small group experience in living, learning, traveling, and studying. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375E. International Travel & Study Abroad: Microcredit, Microfinance, and Social Development in Bangladesh. 3 Units.
This International travel/study course to Bangladesh is taught by SUIC School of Social Work, Case Western Reserve's Mandel School of Applied Social Sciences (MSASS), and Independent University, Bangladesh. Many international scholars and leaders will be involved, including 2006 Nobel Peace Prize winner Muhammad Yunus, as well as other officials in Bangladesh. The program will provide an intensive learning experience that will take students to Bangladesh for 12 days. The course to Bangladesh will be focusing on the role of Micro-credit and Microfinance and Social Developments to alleviate poverty and nurture social entrepreneurship. Students will spend 8 days in Dhaka, the Bangladesh capital, and 4 days in the villages visiting field projects. The program will provide lectures and field trips involving social, political, economic and developmental aspects of Micro-Credit and Micro-Finance. The trip will explore the basic ideas behind the Microcredit revolution in Bangladesh, its historical precedence, and will study it's relation to health, finance, management, politics, social entrepreneurship and development. Student will learn about the mechanisms of micro-credit in social development and execute the knowledge in their own practice. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375F. Gender and Sexuality Justice: LGBTQ life in Contemporary Dutch Culture. 3 Units.
This experiential and hands-on course explores the Dutch concept of "tolerance" through the lenses of sexuality, gender identity and gender expression. The course will investigate the Dutch concept of "tolerance" as it applies to non-heteronormative sexualities, as well as the range of gender identities and expressions outside of a binary of male/female, man/woman. Focusing on, but not limited to, the lesbian, gay, bisexual, transgender, queer (LGBTQ) community, the course will interrogate the ways in which the social discourse of acceptance is complicated by other salient sociopolitical factors present in the Netherlands such as historical and contemporary realities about immigration, religious diversity, age, ethnicity and race. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375G. Global Health and Social Development in India. 3 Units.
The study abroad program explores the innovative approaches to health and social development in India and draws parallel to that of the United States. The purpose of the trip is to familiarize students with Indian social development and social policy issues in regards to multicultural aspects of healthcare, poverty alleviation, non-formal education, and application of information communication technologies in addressing social problems. The trip will include guided tours to neighborhoods, field-action project sites, health, social and educational institutions and government establishments. Daily lectures by practicing social workers, healthcare professionals, policy advocates, field workers, government officials and eminent Indian scholars and researchers will further enhance students’ understanding. This study abroad course will also acquaint students with history and culture of India, its social, political and economic development and the impact it has on the delivery of social services The course will be taught using both lecture and experiential modalities. Along with visiting a variety of governmental and non-governmental institutions, health care facilities, organizations and projects, students will visit historical sites and attend cultural events. Counts for CAS Global & Cultural Diversity Requirement.
SASS 375H. 21st Century Ghana: Culture, Institutions & Development in West Africa. 3 Units.
This two-week study abroad program to Ghana, West Africa will introduce students to the history and culture of Ghana, its social, political and economic development, and current social issues and institutional responses. Among the specific social issues to be examined in the course are health, education and community development. We will pay particular attention to understanding how the role of culture, faith and religion is shaping institutional, community and individual responses to the challenges and opportunities of globalization and development. The course will be taught using a combination of lectures, individual and group exercises and experiential learning, including a community service project, a brief home-stay for each student with a Ghanaian family and a day of work shadowing with a Ghanaian professional. Along with lectures from local academics and interaction with a variety of institutions and agencies, students will visit historical sites and attend cultural events. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375I. Global Issues, Health, & Sustainability in India. 3 Units.
Global Issues, Health, & Sustainability in India is an interdisciplinary social work and engineering collaboration that includes a short-term cross-cultural immersion. This course brings together social work (knowledge, values, and skills) and health care (promotion, education, and community) perspectives to the understanding of technical project assessment, selection, planning and implementation in India. The course is also designed to help students understand culturally relevant community engagement strategies to ensure project acceptance in underserved and developing communities. Many field sites will be visited in order to observe first-hand the community assessment and development of projects that engineers implement. An example of these projects could include infrastructure to support green energy and water (resource planning, development, conservation, and sanitation). This study abroad course will acquaint students with history and culture of India, its social, political and economic development and the impact it has on health and the delivery of social services. Participants will learn about factors affecting the abilities to reach, treat, educate, and equip communities to improve health outcomes. Engineering students will learn the quantitative aspects using a paradigm of hierarchical systems, mathematical modeling, and scenario analysis using a ‘reasoning support’ system. Together the engineering, social work, and health sciences students in disciplinary-balanced teams will jointly work on real and meaningful projects marrying the descriptive scenarios (that is the ‘subjective’ aspect) with the numerical scenario analysis based on mathematical modeling (or ‘objective’ aspect) to form a coherent view of the future. The course will be taught using both lecture and experiential modalities. Engineering students will conduct computer modeling work. Along with visiting a variety of governmental and non-governmental institutions, organizations and projects, students will visit historical sites and attend cultural events. Offered as EECS 342I and SASS 375I. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375J. International Travel & Study Abroad: Child Development/ Child Welfare Nicaragua. 3 Units.
This four-week study abroad program to Nicaragua, Central America will introduce students to the history and culture of Nicaragua, its social, political and economic development, and current child development/health/child welfare issues. The program will focus on Spanish language acquisition or mastery along with substantive study in either child development & health or child welfare, depending on student interest. Counts for CAS Global & Cultural Diversity Requirement.

SASS 375L. South Africa / Social Justice/S.W., International Learning through Community Immersion & Internship. 3 Units.
This three-credit course will be conducted in partnership with Educo Africa in Cape Town, South Africa. The course will provide experiential and service learning social work experiences in a nation still experiencing the lingering effects of decades of apartheid rule as well as the co-existence of developed and developing worlds within the boundaries of the country. Course activities will encourage cross cultural learning experiences to increase knowledge pertinent to South Africa’s social, cultural, environmental, political and historical reality. It will expose students to community development challenges as well as environmental and social justice issues in a South African context. The goal of the course is to increase personal, community and global leadership potential of social work and social development professionals. This course in partnership to Educo Africa will use a community-based context to increase the effectiveness and expertise of students and will support student’s engagement in program development and building international networks and partnerships.

SASS 375M. 21st Century South Africa: Culture, Institutions & Development in South Africa. 3 Units.
This two-week study abroad program to South Africa, South Africa will introduce students to the history and culture of South Africa, its social, political and economic development, and current social issues and institutional responses. Among the specific social issues to be examined in the course are health, education and community development. We will pay particular attention to understanding how the role of culture, faith and religion is shaping institutional, community and individual responses to the challenges and opportunities of globalization and development. The course will be taught using a combination of lectures, individual and group exercises and experiential learning, including a community service project, a brief home-stay for each student with a South African family and a day of work shadowing with a South African professional. Along with lectures from local academics and interaction with a variety of institutions and agencies, students will visit historical sites and attend cultural events. Counts for CAS Global & Cultural Diversity Requirement.

SASS 385. Social Welfare Capstone Seminar. 3 Units.
This seminar course will revolve around the identification and critical investigation of current social problems. Insights gained from social welfare research will be applied to better understand these problems. Successful completion of the course will require critical analysis of published research, integration of information from social work and different disciplines, an oral presentation and a final written research report including a literature review. Counts as SAGES Senior Capstone.

SASS 390. Independent Study for Undergraduates. 1 - 3 Units.
Individual study in Applied Social Sciences involving specific programs of reading, research, and special projects. Requires prior approval of faculty member directing the project. Recommended preparation: 12 hours of social science courses; approval of MSASS Associate Dean.

SASS 405. Nonprofit Ethics and Professionalism. 3 Units.
This course is an application of ethical frameworks and analysis to nonprofit organizations. Using cases and essays, the course will help nonprofit managers become better equipped to address ethical problems and dilemmas in their work in the following areas: ethics of boards, ethics and leadership, ethics and organizational culture, professional ethics, and ethics and fundraising.

SASS 406. Nonprofit Public Policy and Advocacy. 3 Units.
This course is an introduction to the institutions and processes that make up the political environment of nonprofit organizations in the United States. The course will examine the role of civil society in a democracy, take a general overview of American political institutions and the cultural beliefs that undergird them, and examine the important elements of the public policy process: the framing of issues, the role of political entrepreneurs and organized interests, elections, the legislative process and strategies for influencing it, and the roles of executive institutions and the courts. Emphasis will be placed on the ways that nonprofit advocates can advance their goals in the public policy process.

SASS 407. Nonprofit Revenue Planning and Development. 3 Units.
Revenue strategy and development are critical in advancing the mission and core work of a nonprofit organization, and are among the most strategic responsibilities held by an executive director and his/her board. Nonprofits face a myriad of revenue options which could be pursued but each of these has implications for how the organization advances its mission and its sustainability. The course will examine how to assess these revenue sources and evaluate how they can contribute to an organization’s overall financial vitality.
SASS 408. Nonprofit Philanthropic Fundraising. 3 Units.
This course will provide current and future nonprofit leaders with a detailed survey of the practices, principles, and process of fundraising, enabling them to effectively create, participate in, and manage fund development programs and staff. Successful fundraising is shown to be communication-based and built upon solid relationships with defined constituencies of donors and potential donors.

SASS 409. Nonprofit Strategic Planning. 3 Units.
This is an integrated practicum designed to provide "hands-on" experience in planning for, designing, and conducting strategic planning in nonprofit organizations. Students will learn to assess organizational readiness, facilitate the design of strategic planning processes, create a variety of approaches involving key stakeholders, and finalize a planning design suited to organizational culture.

SASS 410. Nonprofit Databased Decision-Making. 3 Units.
Nonprofit leaders face a wide range of data needs and opportunities to use data to inform strategy and practice. This course is designed to give students a working knowledge of data analysis, statistical concepts, research designs for program planning and evaluation, and techniques for problem solving. By exploring a continuum of decision making opportunities in the nonprofit sector, the course will present methods and frameworks for collecting and interpreting data to inform organizational action.

SASS 411. Nonprofit Leadership Dialogs. 1 - 3 Units.
This course is intended to enable students to learn about major nonprofit leadership issues and trends through interaction and dialog with successful nonprofit leaders. It is also designed to provide outside nonprofit leaders with the opportunity to learn about the quality of the Mandel Center’s student body.

SASS 420. Nonprofit Organization and Management. 3 Units.
This course will focus on theories of organizations and general concepts and principles of management, governance, and leadership. Organizational design, behavior, performance, and effectiveness will be studied, and the special character and management problems of nonprofit organizations will be highlighted and analyzed.

SASS 422. Nonprofit Assessment and Program Evaluation. 3 Units.
The course is designed to introduce students to the approaches to organizational assessment and evaluation of organizational issues and problems. The class will explore a variety of ways of viewing organizations, assessing their stage of development, look at factors that influence or interfere with their forward progress, review the dimensions essential to nonprofit organizations and explore some processes useful to enable change. In addition, the course will focus on the process of creating and measuring program outcomes.

SASS 424. Nonprofit Economics. 3 Units.
This course is designed to familiarize students with basic ideas of microeconomic analysis so that they may apply this reasoning to important resource-related decisions facing contemporary nonprofit organizations. This introductory course will orient the student to the role of nonprofit organizations in a market economy, familiarizing the student with basic concepts of microeconomic analysis and how they apply to resource-related decisions, and provide the student with tools and concepts for analyzing pricing, compensation, outsourcing, investment of funds, and engaging in partnerships.

SASS 425. Nonprofit Financial Management. 3 Units.
This course focuses on techniques and principles of financial management including budgeting, finance and investment decision making. Topics include budget formulation, analysis and planning, present value analysis, cost-effectiveness, cash flow analysis, portfolio management, and venture planning. Special emphasis will be given to the unique problems of nonprofits in capital formation, generating earned income, managing endowments, gifts and grants, and tax planning.

SASS 426. Research Methods in Social Work. 3 Units.
This course provides an overview of the basic concepts used in the conduct of scientific inquiry and the tools of research methodology. It introduces students to the issues involved in the design, implementation, analysis and utilization of social research. Students are encouraged to focus on a practice-related research problem in their individual or group research projects, as well as to focus on research issues relevant to their specialization, field of practice, or field of practicum setting. Students are alerted to the risks of cultural bias in research throughout the course through examples and scientific readings.

SASS 427. International Non-Governmental Organizations. 3 Units.
This course examines the role of voluntary associations in the international arena and, in particular, the multiple roles of international non-governmental organizations in affecting international political and economic outcomes. The course also examines the theoretical issues surrounding NGOs and international relations, particularly the relationship between global civil society and international political outcomes.

SASS 428. Trusteeship: Nonprofit Governance. 3 Units.
This elective course deals with the definition, history and concept of trusteeship, the areas of responsibilities of Boards of Trustees, the authority of Boards and the limits on its exercise, the organization of Boards and their committees, and the Board’s relationships with the Executive Director, the staff and the organization’s constituencies. Eligible for M.B.A. credit.

SASS 430. Nonprofit Human Resources. 3 Units.
Theories and principles of managing people in organizations are addressed in this course, including motivation theory and human resource development strategies. Particular attention is devoted to issues critical to nonprofit organizations, such as the management of volunteers, management of professionals, working with trustees, and staff/board relationships.

SASS 432. Nonprofit Marketing. 3 Units.
This course provides students with a comprehensive overview of the principles and techniques of nonprofit marketing and an understanding of the multiple contexts in which they are applicable—marketing of products and services, marketing to potential funders, marketing of ideas and behaviors (social marketing and advocacy). The focus of the course is on managerial decision-making to achieve organizational objectives and enhance organizational viability.
SASS 440. Human Development I: Child and Adolescent. 3 Units.
This course offers an overview of normal individual development throughout the life cycle. Psychosocial theory, learning theories, and social role theory constitute the theoretical base for this foundation course. Developmentally determined objectives and tasks for every life stage are examined in the context of biological, genetic, psychological, familial, and sociocultural factors. Special emphasis is placed on the impact of gender, health, and minority status, and on community institutions of human development. This course supports the foundation social work methods course by introducing substantive content on human development as a framework for assessment, prevention, and intervention with psychosocial problems. Curricularly related to the advanced sociobehavioral courses on human development and developmental dysfunction, this course provides a basic understanding of normal human development, which can serve as a contextual framework for developmental deviations from the norm.

SASS 441. Human Development II: Adult. 3 Units.
This course builds on SASS 440 Human Development I (child & adolescent) by compassing the general themes of feeling (emotion), thinking (cognition), and acting (behavior) with adult emotional, cognitive, and behavioral development. Students will understand the differences and similarities between earlier (child and adolescent) and later (adult, including older adult) emotional, cognitive, and behavioral development by examining, across the life-span, the idea/concept of: (1) adult development as gains/losses, (2) adult development as plasticity and variation (i.e., development can take many forms and can change), (3) adult development as risks, conflicts, protective factors, and resilience and (4) adult development as context (e.g., family, society, gender culture, ethnicity, social class, discrimination, sexual orientation, and socio-historical (i.e., cohort contexts). Prereq: SASS 440.

SASS 450. Nonprofit Law. 3 Units.
This course provides the student with a basic grounding in the laws and regulations governing nonprofit organizations. Content will include the procedures for incorporating, reporting, and maintaining tax-exempt status as a nonprofit organization, a familiarity with legal principles and research methods, and an overview of the legal, regulatory, and policy issues facing contemporary nonprofit organizations.

SASS 470. Social Policy. 3 Units.
This course provides basic perspectives on social policies related to poverty, health, aging, mental health, substance abuse, and discrimination. An analytical framework is used to systematically identify, define, and analyze social problems and policies. The course also introduces the student to social planning and service delivery.

SASS 477. Direct Practice Generalist Methods & Skills. 3 Units.
The goal of this course is to develop culturally competent social work generalist practitioners who are armed with the knowledge and skills necessary to practice ethically with individuals and families in diverse social work practice settings. The course introduces major social work theories (i.e., systems-ecological theory) and intervention approaches (i.e., problem-solving). Understanding and practicing the skills necessary to carry out generalist practice will be a major focus on both lectures and skills lab.

SASS 478. Macro and Policy Practice Skills. 3 Units.
This course focuses on the development and application of practice skills in work with task groups, communities, and social policy institutions. It includes both didactic and experiential teaching and learning. The course is built on first semester foundation learning, particularly in the areas of social policy, diversity, discrimination, and oppression, and the direct practice skills lab. It will also draw on knowledge taught in the second semester course on theories of groups, organizations, and communities. Finally, there will be interaction with the field seminar and the field practicum. Prereq: SASS 477.

SASS 484. Theories of Oppression and Social Justice. 3 Units.
This course provides students with a basis for developing their ability to value a diverse world and to understand how discrimination and oppression operate to limit the life opportunities of members of minority and disenfranchised groups. Students will have the opportunity to develop and enhance their personal and professional awareness of their own cultural identity and to use this as a basis for developing their competence to work with individuals and groups different from themselves. Selected theoretical perspectives will provide a descriptive and explanatory framework for critically analyzing the manifestation of discrimination and oppression and their impact on the affected populations. Social work’s response to discrimination and oppression within the profession and in society at large will also be examined.

SASS 495. Field Education Seminar. 1 Unit.
This seminar prepares students for entry into field education. The course introduces students to a number of topics that are considered basic to beginning the social work field practicum.

SASS 495V. Field Education Seminar. 1 Unit.
The Field Education Seminar provides the support and guidance necessary to assist foundation social work students to identify and finalize a field placement location. This course also prepares students for the upcoming field experience through self-assessments, discussions and reflective activities. This is a 16 week course.

SASS 500. Special Topics in Applied Social Sciences. 1 - 6 Units.
SASS 501. Nonprofit Practicum. 0 - 6 Units.
The overall goal of this course is to provide MNO students the opportunity to develop a practicum experience in a non-profit organizational setting. The course is designed to enhance knowledge acquired in the classroom by allowing students the flexibility to develop an individualized plan that will integrate professional practice skill development. The students will work closely with their Academic Advisor to determine whether a practicum meets the student’s learning needs. The student will also be assigned a Practicum Instructor, who is based at the non-profit setting and provides the direct instruction of the student. Finally, the student will work with the Faculty Advisor, who is based at the School and serves as a link between all parties, oversees the requirements and standards of the School, and participates and consults in the design of the student’s learning experience. The Student, Practicum Instructor, and Faculty Advisor all participate in various ways in the evaluation of student’s practicum; the Faculty Advisor is responsible for assigning the grade.
SASS 505. Adoption: Practice and Policy. 3 Units.
This course covers the concepts, knowledge, skills, and policies associated with contemporary adoption practice. The practice method reflects a triad perspective, meaning that adoption is examined from the viewpoints of birth parents, adoptees, and adoptive parents. For each topic area, social work roles, activities, tasks, and skills are explored along with policy issues. Exemplars and case studies are presented for illustration purposes. Consideration of triad needs at different life cycle stages are presented. The issues of ethnically competent adoption practice are emphasized throughout the course in each content area.

SASS 506. Perspectives on Management and Leadership. 0 Unit.
This course is designed to explore management and leadership capabilities. The class explores personal and organizational aspects of leadership and management examining theoretical perspectives and models, governance, communication, advocacy, ethics and accountability. In addition, the course examines key tools for effective management and leadership to manage risk, challenges, building consensus and collaboration. The course also guides students through a personal leadership development journey. The classroom will serve as an interactive learning environment. Students will learn management and leadership abilities from readings, lecture, group discussion, reflection, assessment, planning and application. The content of the course integrates research across social work, business, the nonprofit sector, and literature to inform a solid perspective to enhance management and leadership capabilities. This course includes activities and feedback for students to facilitate growth and development, and is appropriate for students who want to become effective managers and leaders, growing related abilities and knowledge.

SASS 510. Health Disparities. 3 Units.
This course aims to provide theoretical and application tools for students from many disciplinary backgrounds to conduct research and develop interventions to reduce health disparities. The course will be situated contextually within the historical record of the United States, reviewing social, political, economic, cultural, legal, and ethical theories related to disparities in general, with a central focus on health disparities. Several frameworks regarding health disparities will be used for investigating and discussing the empirical evidence on disparities among other subgroups (e.g., the poor, women, uninsured, disabled, and non-English speaking populations) will also be included and discussed. Students will be expected to develop a research proposal (observational, clinical, and/or intervention) rooted in their disciplinary background that will incorporate materials from the various perspectives presented throughout the course, with the objective of developing and reinforcing a more comprehensive approach to current practices within their fields. Offered as CRSP 510, PQHS 510, MPH 510, NURS 510, and SASS 510.

SASS 511. Issues in Health Policy and Service Delivery. 3 Units.
This course examines health care policy issues and options, and highlights the development of health care policy in the U.S., the influence of health policy development, and the role of social work. It also examines the problems, policy, and program issues in the subsidy, financing, reorganization, and regulatory capacity of health policy. National, state, and local issues will be stressed. The course is for students in the health concentration but also welcomes students from other areas. Prereq: SASS 470 or SASS 400-TR.

SASS 512. Legislative and Political Process. 3 Units.
This course focuses on how to deal effectively with legislators, their staff, and legislative systems. The roles of money and information in legislative and political systems are examined. The process through which a bill moves to become law is explored, including critical points of intervention in that process. Lobbying legislators, including presentation of testimony and use of coalitions, is featured. Prereq: SASS 470 or SASS 400-TR.

SASS 513. Aging Policy and Service Delivery. 3 Units.
This course reviews current income, health, and social service policies for older Americans. It also investigates patterns and levels of care for the elderly. Trends and issues in policies and programs for seniors are analyzed in the context of the dimensions and differential characteristics of the aging population in the country. Some cross-national comparisons of services for the elderly are included in this analysis. Prereq: SASS 470 or SASS 400-TR.

SASS 514. Mental Health Policy and Service Delivery. 3 Units.
This course is designed for students preparing for careers as social workers in the mental health field with an understanding of mental health policy and service delivery at the federal, state, and local levels. Through readings, lectures, discussion, and written assignments, the course will aid students in developing a macro-level perspective of mental health policies and programs. Prereq: SASS 470 or SASS 400-TR.

SASS 515. Family Caregiving. 3 Units.
The purpose of this interdisciplinary graduate-level seminar is to explore the theoretical research, policy, and practice issues related to informal caregiving of the elderly. Topics will include the historical and cultural context of family caregiving, theoretical paradigms (i.e., adult development, stress and coping), characteristics of caregivers (i.e., gender, relationship, race, ethnicity, employment status, geographical setting), characteristics of the elderly care-receiver (i.e., type of cognitive and physical impairments), ethics, physical and mental health outcomes, service delivery issues, institutionalization, and bereavement. Through readings, discussions, guest lectures, and paper presentations, students will learn about the complexities of informal caregiving of the elderly from a range of disciplinary perspectives in order to improve assessment and practice skills in a variety of settings. Students are encouraged to focus on issues relevant to their discipline, specialization, or field of practice for their seminar papers.

SASS 516. Alcohol and Other Drug Abuse Policy and Service Delivery. 3 Units.
This course explores selected current alcohol and other drug abuse (AODA) problems using a problem analysis framework. Emphasis is placed on current and past AODA problem definitions as they affect policy and program development. Conceptualization of the problems resulting from AODA patterns of use and abuse, causation theories, the impact of cultural and social diversity as well as discrimination upon all client systems, and the role of local and national institutions which advocate for this population group are reviewed. Prereq: SASS 470 or SASS 400-TR.

SASS 517. Family System Interventions. 3 Units.
This course covers the knowledge, concepts, and skills associated with working families. The practice method will reflect a family systems approach, integrating theories and approaches within a systemic perspective. It will build practice skills in assessing, interviewing, and intervening with families and emphasize a strength-based perspective on intervention with families. Considerations of family issues at different developmental stages will be presented. The issue of ethically competent and community-based social work practice with families will be stressed throughout the course for each content area. Prereq: SASS 477 or SASS 400-TR.
SASS 518. Social Work with Death, Grief and Loss. 3 Units.
This course focuses on the concept of death and related topics from a social work perspective. Such topics include the role of death in American culture; the dying process and its institutions; assessment and intervention strategies; life span and family life considerations; and end-of-life decisions. The course provides both theoretical and experiential exposure to the dying process as it relates to self, the dying person, and the bereaved. Students will gain insight into serving the terminally ill, those who need assistance with mourning and grief, and clients dealing with difficult life-and-death decisions regarding loved ones. Prereq: SASS 477 or SASS 400-TR.

SASS 519. Children and Families in the School Setting. 3 Units.
This course prepares students to be certified school social workers. The course addresses major issues in American schools; a theoretical framework for school social work services; design, deliverance, and evaluation of school social work services; legal and ethical issues; and the roles and intervention strategies of school social workers. It covers student and family problems and areas of need such as disability, truancy, divorce, teen pregnancy, youth depression and suicide, substance abuse, violence, and dropping out of school. This course is required for those participating in a planned program of study leading to state certification as a school social worker. If space permits, other students may enroll if they have or have had school social work experience. Prereq: SASS 477 or SASS 400-TR.

SASS 520. Homelessness Policy and Service Delivery. 3 Units.
This course provides an understanding of homelessness and its incidence and prevalence, its origins, both historical and social, its consequences, and policy-based strategies for its prevention. The course investigates the impact of homelessness on single individuals, families with children, minorities, and vulnerable populations such as the mentally ill and alcoholics. Students, organized into a task force, examine a range of professional and community-based responses to the problem. The task force method enables students to assess the effects of public policy on homeless people, critique the effectiveness and adequacy of local shelter and service programs, and propose community-based strategies to prevent, stop, and better homelessness. Prereq: SASS 470 or SASS 400-TR.

SASS 521. Supervision. 3 Units.
The course focuses on the role of strength-based supervision in improving outcomes clients served in the various social service and nonprofit systems, and on developing the skills necessary for effective supervision and leadership. The course examines the context of contemporary supervision, and presents models of supervision grounded in systems theory, developmental theory, and social justice theory. This course is also designed to build practical skills for organizational leadership, focusing on adaptive leadership.

SASS 522. Motivational Interviewing. 3 Units.
This advanced methods course provides a basic orientation to the concepts in Motivational Interviewing, which is a collaborative, person-centered form of eliciting and strengthening motivation for change. It is a way of working with persons to assist them in accessing their intrinsic motivation to change behaviors that contradict their essential values and interfere with the achievement of their life goals. Motivational Interviewing is both a philosophy and a set of strategic techniques. It is an evidence-based treatment with a broad range of applications. The course will place an emphasis on individuals with severe and persistent mental illness and/or substance use disorders. Specific techniques to recognize, elicit and strengthen change talk, as well as responding to resistance and consolidating a person's commitment to change will be explored. Exercises and examples specific to the unique practice setting of participants will be incorporated. Students will have an opportunity to practice these techniques in role-real-play and other group exercises as well as measure skill application and provide meaningful feedback to their peers. Prereq: SASS 477 or SASS 400-TR.

SASS 524. Social Work with Military Veterans and their Families. 3 Units.
Military Social Work is an advanced direct practice concentration course designed to educate social workers in the needs of military service members on active duty and during transition to civilian life. SASS 477, SASS 547 and SASS 549 are pre-requisites for this course. The course takes the perspective that uniformed forces have a specific culture, rules of conduct, and identifiable bio-psycho-social concerns related to military service. This specificity requires social worker to learn about evidence-based military practice behaviors and core competencies working with members of any branch of the Department of Defense (DoD) and Veterans Affairs (VA). This course will help students to understand military culture, to recognize stressors related to military service and to address mental health problems affecting military personnel and their families. The course will use case materials to illustrate similarities and differences among various populations including minority/ethnic identity groups. Students will have opportunities to work on the following abilities: The Revised MSASS Abilities: 1. Identify as a Reflective Professional Social Worker 2. Advocate for Social, Economic and Environmental Justice 3. Apply Social Work Methods 4. Uphold Social Work Values and Ethics 5. Integrate Cultural, Economic, and Global Diversity 6. Think Critically about Theory and Research Knowledge 7. Communicate Effectively 8. Develop as a Social Work Leader Prereq: SASS 477, SASS 547 and SASS 549.

SASS 525. AIDS Seminar. 3 Units.
This course is designed to provide an understanding of HIV/AIDS. The nature and prevalence of the disease, including its impact upon vulnerable populations such as children and youth, women, gay and lesbian populations, people of color, prisoners, IV drug users, and street people are examined. The course focuses on public policies, programs, and service delivery for HIV/AIDS at local, state, and national levels. Topics include the policy-making role of advocacy groups, the function of AIDS service organizations, and the design of educational and preventive programs. Prereq: SASS 470 or SASS 400-TR.
SASS 527. The Theory and Practice of Leadership. 3 Units.
This course assists students preparing for management and leadership roles in social service organizations to understand theories of leadership and translate them into effective leadership practices. The class explores leadership definitions, tasks and responsibilities, and the development of leadership capabilities. Students also examine their personal values, beliefs, skills, and understanding of ethical principles underlying leadership. Prereq: SASS 440 or SASS 400-TR.

SASS 529. Child and Family Policy and Service Delivery. 3 Units.
This course focuses on major federal legislation impacting children, youth, and families, examined in the context of community based social work policy/practice. It builds upon the foundation course in social welfare policy and enables students to use an advocacy approach to provide policy-informed services and to participate in policy and implementation and change. Prereq: SASS 470 or SASS 400-TR.

SASS 530. Practice Evaluation. 3 Units.
This advanced course prepares direct practice students to examine their own practice with individuals, families, and groups. Attention is given to basic principles of measurement and selection of appropriate measurement instruments for use in direct practice settings. The course is intended to provide students with the technical skills necessary to investigate the components of social work practice and contribute to an empirically validated social work knowledge base. The student is asked to determine the efficacy of his/her practice intervention in field placement by using a suitable design and method. A hands-on project is required using clinical experience from field practice. Prereq: SASS 426 and SRCH 426 or SASS 400-TR.

SASS 531. Collaboration & Strategic Partnerships. 3 Units.
The development of strategic alliances is being used increasingly as a key for nonprofit organizations to carry out their missions. This course is designed to provide students with the conceptual and practical resources necessary for leadership in the formation and maintenance of such alliances. Various models and strategies for creating and sustaining local, community-based, and national relationships are explored. The course is based on "practical theory" builds on current knowledge about creating mulch-organizational partnerships, and expands capabilities to participate in these efforts. The overarching goals of this course are that students, as members of this "learning community," will (a) develop a deeper understanding of the core knowledge required for successful collaboration, (b) deepen their appreciation of the values and ethics involved in creating strategic alliances, and (c) enhance their ability to apply acquired skills in the area of inter-organizational relations. Prereq: SASS 477 and SASS 478 or SASS 400-TR.

SASS 532. Needs Assessment and Program Evaluation. 3 Units.
This course covers research methods and analytic tools that are used in communities and organizations to plan, monitor and evaluate programs, projects and initiatives. It builds upon the research methods course in the foundation curriculum and deepens and expands this content at the advanced level. The content prepares students to use quantitative and qualitative research methods to plan and evaluate programs, policies and practices. The class covers the conceptual and technical aspects of conducting needs assessment in and applying the tools and findings to the community, program and organizational development process. The course employs a circle perspective with the goal that students will be able to judge the strengths and weaknesses of various tools and approaches and the degree to which ethical standards have been met. Students are introduced to a variety of methods for community and needs assessment, demographic, statistical and geographic analysis, qualitative and quantitative data gathering methods, and program and policy evaluation designs. The importance of conducting research in ways that respect cultural diversity and are valid across diverse populations is emphasized. The practical aspects of using data to drive decision making, quality improvement, outcomes management and the engagement of partners and stakeholders are also covered in the course. This course is structured to have a strong emphasis on skill development in data gathering, analysis and application. Prereq: SASS 426 or SRCH 426 or SASS 400-TR.

SASS 534. Theoretical Contexts Shaping Community Practice. 3 Units.
The aim of the course is to provide students in the Community Practice for Social Change concentration with a thorough overview and analysis of the range of individual, group, organizational and community-level theories that inform our practice with organizations, neighborhoods, communities, social institutions and policies. The course seeks to help students: (1) develop an appreciation of the main traditions, theoretical debates, experiences and research findings in community practice both as a change process and as an interdisciplinary field; (2) identify the key ideological assumptions underlying these theories with attention to the broader historical, economic, social, demographic, institutional and political influences that affect these assumptions as well as resultant practice both in the United States and internationally; (3) identify, articulate and apply theories of change through the practice of theorizing; and (4) understand and apply logic models for community problem solving. The course emphasizes application of theory to practice settings and developing skills and competencies for community work in diverse settings.

SASS 535. Human Sexuality. 3 Units.
The course addresses sexuality as an integral part of human functioning and human relationships throughout the life cycle. The formation of sexual identity is addressed, including gender identity, sexual orientation, and sexual intention. The physiological and psychological aspects of sexual behavior are covered, including the effects of aging, chronic illness, and sexually transmitted diseases. The course concludes with practical applications for social work, including an overview of assessment and treatment of sexual dysfunction. Prereq: SASS 440 or SASS 400-TR.

SASS 536. Individual Research Practicum. 3 Units.
With instructor and research sequence chair approval, an individual program of supervised research experience may be undertaken. This course allows the student to tailor a program of applied research to a specific practice issue or program. Prereq: SASS 426 or SASS 400-TR.
SASS 538. Evidence-Based Practice: Selection, Implementation, and Practice Issues. 3 Units.
This course prepares students to critically assess and reflect on evidence-based practice theory, principles, and practice issues as they relate to social work. Students will integrate knowledge of assessment and clinical treatments with the growing research and science base of evidence-based practice. The course will focus on multiple levels of evidence-based practice promotion including the individual level, the programmatic and agency level, and the broader market place contexts. In the beginning of the course, students will be introduced to the history and background of the evidence-based practice movement, including definitions and terms. Students will also examine how to incorporate strategies optimizing client needs and circumstances into the EBP decision-making process, and to think critically about how to ensure that their practice adheres to social work values and ethics. Students will learn issues and strategies for locating, selecting, and evaluating EBP practice research, including the selection of EBPs tailored to a specific client or population. On the programmatic and agency levels, students will examine core implementation components and challenges (e.g., planning, educating, financing, restructuring, managing quality, attaining to policy) commonly faced in agency practice by clinicians, supervisors and administrators. As students are exposed to the implementation science literature and research, they will appreciate how key multilevel implementation approaches can be designed and applied to promote health and behavioral health innovation on both the prevention and intervention levels. Finally, students will review that EBP landscape from a broader perspectives including prevention science, and the diffusion of innovations, examining important controversies and market trends that influence and impact contemporary evidence-based practice in social work. Prereq: SASS 477 and SASS 478.

SASS 539. Early Intervention: Theories and Practice. 1 - 3 Units.
This course both describes the characteristics of young children with disabilities and examines the intervention models and practices that are used to address the developmental and social-emotional needs of these children. The course describes the legislative and philosophical foundations for contemporary early intervention practice. It discusses the meaning of evidence based practice and examines contemporary early intervention practices from this perspective. The readings and assignments for this course have been designed to reflect the course objectives.

SASS 539A. Early Intervention Practicum. 0 Unit.
This practicum course is zero academic credit hour for students who have been selected for the Early Intervention Traineeship program. Students will work with the practicum instructor to complete 60 hours of experience in early intervention.

SASS 545. Program Design. 3 Units.
Program design and development are of critical importance in nonprofit organizations. In this course students will gain a practical, hands-on understanding of strategies for designing programs. The course focuses on program development approaches that attempt to maximize a program’s relevance to the need being addressed and increase the likelihood that the program will attain its identified outcomes. Emphasis is placed on learning to understand a community’s need/problem, reviewing evidence on potential strategies and identifying promising practices, anticipating potential implementation challenges and addressing them, and identifying potential funders. The link between program design and the development of effective program proposals is stressed. Through this course students will have the opportunity to design a program using a specific analytic framework. Students will learn: (1) to address the demands of multiple constituencies and competing values in program development process, (2) skills for developing and implementing programs in the nonprofit sector, and (3) to examine issues of diversity as they affect organizations and community efforts and explore personal values and ethics as these influence programs and interventions.

SASS 546. Poverty Strategies for Social Workers. 3 Units.
This course provides an understanding of poverty. It examines poverty through an exploration of its causes, theory, policy strategies for its amelioration and practice implications. The course investigates the impact of poverty on individual households, families with children, minorities, and vulnerable populations. The course will examine welfare reform and its impact in bringing people out of poverty. Students, in teams, will examine one facet of poverty—its theories, policies, impacts on individuals and families, potential solutions, and our approaches to the issues as social workers. In addition to assigned texts and readings, the course will be supplemented by practitioners, organizers, and low-income persons addressing the issues of poverty. Prereq: SASS 440 or SASS 400-TR.

SASS 547. Problem Identification, Screening and Assessment/Diagnosis. 3 Units.
This course will provide a bio-psycho-social approach to identification, screening, assessment and diagnoses of common psychosocial problems/dysfunctions experienced clients. This course introduces the student to the etiology, recognition and diagnoses of these problems in the context of social work practice. Through use of a competency-based model, students will be introduced to techniques used to screen, assess and diagnose problems such as serious mental illness, suicidality, depression and anxiety, substance abuse, child abuse, elder abuse, and exposure trauma. Students will also become familiar with the use of the DSM IV TR in providing axis I diagnostic formulations. A skills-based approach will be used in presenting students with specific screening, assessment and diagnostic protocols. This course is designed to incorporate a range of issues associated with stages across the lifespan from childhood to late life. Prereq: SASS 477 or SASS 400-TR.

SASS 548. International Social Work. 3 Units.
This is an advanced seminar designed for students interested in the international dimensions of the social work profession and social work practice. The seminar focuses on commonalities and differences in the roles and functions of social workers in different nations. It also gives attention to social work as a global profession and social work practice on an international level. Prereq: SASS 477 or SASS 400-TR.
SASS 549. Theory/Practice Approaches in Direct Practice Social Work. 3 Units.
This required, three credit course introduces selected theories and practice approaches commonly used in social work with individuals, families and groups. The course is designed to provide students with knowledge of theoretical explanations and practice frameworks commonly used in direct social work practice. The course also encourages students to apply critical thinking skills to theory and its practical applications. Case presentations, class discussions and assignments will require students to apply various theoretical perspectives to common problems and issues in social work practice. The course will highlight the use of professional social work values and attention to human development issues, diversity and multicultural perspectives as they apply in each theory or framework. Prereq: SASS 477 or SASS 400-TR.

SASS 550. Trauma Informed Social Work Practice with Children & Families. 3 Units.
This course builds on foundation direct practice courses and focuses specifically on children, adolescents and families affected by trauma. It uses both a developmental and an ecological systems perspective recognizing that in order to successfully treat trauma, it is important to not only focus on the individual but also on the family and the larger community environment of which the child or adolescent is a part. It is designed to foster an understanding of the neurobiology of trauma as well as to develop specific skills in interviewing children, child assessment including case formulation, selection of appropriate interventions, and using specific intervention strategies at different levels of the trauma system. Rather than teaching one specific intervention model, students will develop an understanding of the importance of using the empirical literature, critical thinking skills, and clinical judgment to determine how to best intervene. The issues of ethically and culturally competent practice are emphasized throughout the course in each content area. Finally, the impact of secondary trauma on the practitioner is acknowledged and students develop plans for self-care.

SASS 555. Women's Issues. 3 Units.
This course examines theories that are relevant to the development and socialization of women, and discusses issues that are relevant to women's lives within the context of oppression based on sexism, racism, ageism, homophobia, and other forms of discrimination. Emphasis is placed on assisting students in becoming more aware of the issues that are specifically relevant to their own development and socialization, and preparing for effective and sensitive professional practice by increasing knowledge about the issues facing women. Prereq: SASS 440 or SASS 400-TR.

SASS 561. Community Practice Policy: Analyzing and Changing Social Policy. 3 Units.
This course teaches knowledge, values and skills for analyzing and changing social policy. The course uses a policy practice framework to examine the development and implementation of community and social policy and to prepare students to participate in policy change. A Policy Practice Project provides an opportunity for students to develop skills in planning, advocacy, and policy development. Students work in groups to develop and implement a change strategy targeted at the agency or community level. Course content includes policy analysis, logic models, and advocacy methods. The course will also cover essential social policies relevant to community practice including place based and population based policies for improving communities such as community development, employment and housing policies.

SASS 562. Social Work Intervent in Co-occurring Mental and Substance Abuse Disor. 3 Units.
This advanced methods course provides a basic orientation to substance use disorders in persons with mental illness (SAMI). A biopsychosocial framework will be used to explore the etiology, the maintenance and the recovery of both mental and substance use disorders. The historical background of practitioner, programmatic, and institutional barriers that impede the development and application of clinical skills to dually diagnosed individuals will be explored. Emphasis will be placed on strategies for the implementation of services to deal with individuals with co-occurring problems and their families using the evidence-based New Hampshire-Dartmouth Psychiatric Research Center Integrated Treatment (IT) Model. Current assessment techniques and treatment of special populations including, but not limited to: women, minorities, and adolescents will be discussed. Prereq: SASS 477 or SASS 400-TR.

SASS 563. Resources for Community And Social Development. 3 Units.
Students will be able to understand and utilize the methods to identify, garner, and effectively use resources that promote community and social development. These methods can be applied to expanding resources for individuals, families, communities, and society, as well as to generate resources for organizations. While primarily focusing on financial resources, the course will also consider the important means of positioning an agency or organization to attract and receive resources and collaborate with others to put those resources to their most effective use. The skills that students practice in the course will include fund raising, grant development, financing, strategic partnerships and business deals, marketing, etc. The course will introduce proven models, such as low income tax credits, micro-enterprise, individual development accounts, and revolving loan programs. Students will also learn how to analyze and understand key domestic and international policies and institutions (e.g., foundations, banks, businesses, governments, associations) that relate to resources for community and social development.

SASS 564. Social Work Practice in Alcohol and Other Drug Abuse. 3 Units.
SASS 564 is an advanced direct practice concentration course focused upon knowledge, skills and values important for social work practice with people who abuse and/or are dependent on alcohol and other drugs. The content of SASS 564 directly builds upon the foundation direct practice course (SASS 477) and the required advanced course in screening and assessment (SASS 576). SASS 564 takes a bio-psycho-social approach to prevention, assessment and treatment of alcohol and drug abuse and dependency (AODA) problems. This course introduces the student to the etiology and treatment of alcohol and other drug abuse in the context of social work practice. The historical background and the development of the evidence base of alcohol and other drug treatment interventions, self-help groups, and conceptual models of addiction will be presented. Students will explore their own attitudes and values toward AODA problems and how these affect treatment outcome as well as commonly used prevention and treatment approaches in social work with people who abuse and/or are dependent upon alcohol and other drugs. The course will use case materials to illustrate similarities and differences among various populations including minority/ethnic identity groups. Prereq: SASS 477 or SASS 400-TR.
SASS 567. Assessing, Building & Organizing Community. 3 Units.
This course will examine strategies of community and social development, focusing on community as a means of impacting social change and improving the quality of life for individuals and families in low-income urban communities. Students will learn the history, frameworks and models of community building and community organizing. The course will include critical analysis of the goals, strategies, and the potential and the challenges that these efforts have faced and the lessons learned to date. Students will also learn practice skills in the related social processes in the United State and internationally, such as strategic planning, participatory action research, consciousness-raising, and direct action. As community and social development models are presented, students will participate in a comparative analysis of the roles played by community organizers, community builders, community-based organizations, and community initiatives. Through real world experience and case studies, students will develop skills in neighborhood assessment, civic engagement, empowerment, leadership development, group work, relationship building, social capital formation, conflict resolution, democratic process, social policy analysis and change, and other methods.

SASS 569. Planning & Implementing Social Change. 3 Units.
This course builds skills for the design, planning and implementation of social change. The focus of this course is on promoting social change through more strategic and impactful planning, positioning and partnerships. The premise of this course is that the impact and sustainability of programs, initiatives and other change efforts can be strengthened through more effective planning, better strategic positioning and organizational adaptation to external circumstances and trends, and stronger collaborations and partnerships. Students will strengthen their ability to work effectively within organizations, in collaborations and coalitions, and within communities and systems. Course content includes the development of theories of change and action, logic, models, strategic planning, organizational assessment, strategic positioning, collaboration and coalition building, systems reform, and effective working relationships with funders and local intermediaries. A service learning assignment with a community partner. Prereq: SASS 567

SASS 574. Legal Issues in Social Work. 3 Units.
This course explores the legal issues that permeate the social work profession. Starting with a historical examination of our legal systems, the course will illustrate how social work is influenced and shaped by constitutional, statutory, and legal policy constructs. Students will learn about the skills necessary to provide testimony and to conduct forensic interviews, and we will discuss the legal foundation of ethical considerations and social work values. Students will also learn basic skills in how to utilize the law and legal processes to best advocate for clients and address larger social justice issues. By the end of the course, students will understand how social workers can competently navigate the choppy waters of the law in an interdisciplinary professional environment.

SASS 575. Travel and Study Seminar. 3 Units.
This course acquaints the student with the socio-political factors that influence the development of social welfare systems in a selected country and the impact of these systems on the development and functioning of individuals, families, groups, or communities. The role of the emerging social work profession in social change is explored via the social welfare system. Topics focus on the health care, mental health, aging, child, and/or educational systems and are oriented towards direct practice, management, or community development.

SASS 576. Integrative Seminar in Alcohol and Other Drug Abuse Treatment. 3 Units.
This course is an advanced level course in the Alcohol and Other Drug Abuse Specialization that provides opportunities for students to increase their knowledge of topics in the areas of assessment, diagnosis and treatment of alcohol and other drug disorders. The seminar builds upon course material in Foundation Methods (477) and in the advanced methods course (SASS 549 and SASS 564). The seminar is intended to help students understand the evidence base for the treatment of substance use disorders and to explore selected areas of social work practice in intervention in the context of that evidence. Community applications of theory and techniques are stressed. The integrative seminar in AODA Treatment uses a seminar format and provides students the opportunity to interact with treatment professionals from various treatment and practice settings. The seminar formal also facilitates individual learning: each student selects his or her own topic to pursue in depth. Each student is responsible for leading a minimum of one seminar presentation. Each student will select the topic for the seminar in consultation with the instructor. Coreq: SASS 477 and SSWM 564 or SASS 564.

SASS 579. Cognitive Behavioral Interventions. 3 Units.
This course acquaints students with the theoretical, conceptual, and skill bases of several cognitive-behavioral approaches to practice. Topics include assessment, use of tasks and homework, coping skills, cognitive restructuring, and problem solving approaches to practice. The course draws upon students' field and work experiences to illustrate the application of the concepts and skills under discussion. Prereq: SASS 477 or SASS 400-TR

SASS 580. Social Work Practice in Mental Health: Children and Adolescents. 3 Units.
This advanced methods course builds on the content from required foundation social work methods, policy and human development courses including Direct Practice Methods and Skills, Mental Health Policy and Service Delivery. This course complements the content of advanced methods courses including Social Work with People Who Have Chronic Mental Illness, Social Work in Child Abuse and Family Violence, and Interventions in Alcohol and Other Drug Abuse. This course develops biopsychosocial knowledge and intervention techniques related to professional settings specializing in child and adolescent mental health: hospitals, child guidance agencies, family service agencies, mental health centers, and residential treatment centers. Students learn to use development and clinical theory to guide interventions while, maximizing individual strengths, social work treatment centers. Students learn to use development and clinical theory to guide interventions while, maximizing individual strengths, social work values and ethics, and empowerment. Social and economic risk factors, such as poverty, discrimination, and oppression, are considered in the intervention process and in the utilization of mental health services. In addition, students learn to think critically about the myriad ways cultural diversity influences parenting, child and adolescent norms and expectations. Students utilize assessment skills, coupled with knowledge of development and clinical theory to explore clinical case studies. Prereq: SASS 440 and SASS 477 or SASS 400-TR.
SASS 581. Social Work Practice with Older Adults. 3 Units.
This course is an advanced methods course that builds on the knowledge gained in Foundation Methods. The content of SASS 581 directly builds upon the foundation direct practice course (SASS 477) and the required advanced course in screening and assessment (SASS 576). It is also a required course in the Aging Specialization for the MSSA. The course will focus on the persistent principles and emerging emphases in direct practice with older adults and their families. Students will be asked to develop a model of practice based on knowledge of this unique population, social work values, and practice concepts. The course includes special issues in assessment, strengths-base case management, and intervention approaches known to be effective with emotional disorders in older adults. Prereq: SASS 477 or SASS 400-TR.

SASS 582. Social Work in Child Abuse and Family Violence. 3 Units.
This course addresses the etiology, investigation, and treatment of child abuse including sexual abuse and the roles of child welfare, health, and mental health agencies. Particular attention is given to direct work with children and adults who have experienced abuse, and to interventions in instances of family violence. Prereq: SASS 440 and SASS 477 or SASS 400-TR.

SASS 583. Social Work Practice in Mental Health Adults. 3 Units.
This advanced methods course builds on the content from required foundation social work methods, policy, and advanced sociobehavioral theory courses including Direct Practice Methods and Skills, Mental Health Policy and Service Delivery, Advanced Child and Adolescent Development and Dysfunction, and Adult Psychopathology. This course complements the content of advanced methods courses including Social Work with People Who Have Chronic Mental Illness, Social Work in Child Abuse and Family Violence, and Interventions in Alcohol and Other Drug Abuse. This course develops biopsychosocial knowledge and intervention techniques related to professional settings specializing in child and adolescent mental health: hospitals, child guidance agencies, family service agencies, mental health centers, and residential treatment centers. Students learn to use development and clinical theory to guide interventions while, maximizing individual strengths, social work values and ethics, and empowerment. Social and economic risk factors, such as poverty, discrimination, and oppression, are considered in the intervention process and in the utilization of mental health services.
In addition, students learn to think critically about the myriad ways cultural diversity influences parenting, child and adolescent norms and expectations. Students utilize assessment skills, coupled with knowledge of development and clinical theory to explore clinical case studies. Prereq: SASS 477 or SASS 400-TR.

SASS 584. Integrative Seminar in Mental Health: Children and Adolescents. 3 Units.
Integrative Seminar in Mental Health: Children and Adolescents is an advanced level course, a capstone course in the Mental Health Child and Adolescent Specialization, that provides opportunities for students to increase their knowledge of assessment, diagnosis and treatment. This course builds on the course material in SASS 580, SASS 477, SASS 549, and SASS 576. The seminar is intended to help students integrate theory and practice, especially in the context of public mental health and community-based, social service practice. The integrative seminar in Social Work Practice with Children and Adolescents uses a seminar format facilitates individual learning and promotes a learning-to-practice, reflective approach. The seminar assumes there are numerous evidenced-based models and practices and focuses student learning on the role of the professional use of self in the implementation of theory, technique, model, or intervention.

SASS 585. Social Work with Groups. 3 Units.
A theoretical formulation of the social group work method as a problem solving process is addressed. Exercises are presented in the use of diagnostic skills to determine individual needs and problems for which groups may be helpful, the worker’s role in facilitating group functioning through his/her use of various program media. Attention is given to the significance of goals, agency environment, and policy for direct work with groups. Prereq: SASS 477 or SASS 400-TR.

SASS 586. Social Work with Couples. 3 Units.
This course provides an overview of assessment and intervention methods for working with couples around issues of marriage, divorce, and remarriage. Alternate couple forms are discussed. The course emphasizes systems and social learning approaches, communication and negotiation in problem solving and its relevance to assessment, treatment structure, and techniques. Special attention will be given to problem areas such as commitment, sexual dysfunction, chemical dependency, and destructive communication patterns. Prereq: SASS 477 or SASS 400-TR.

SASS 587. Integrative Seminar in Mental Health: Adults. 3 Units.
The Integrative Seminar in Social Work Practice with Adults is an advanced level course, a capstone course in the Mental Health Adult Specialization, that provides opportunities for students to increase their knowledge of assessment, diagnosis and treatment. This course builds on the course material in SASS 583, SASS 477, and SASS 576. The seminar is intended to help students integrate theory and practice, especially in the context of public mental health and community-based, social service practice. The integrative seminar in Social Work Practice with Adults uses a seminar format and provides students the opportunity to interact with professionals, from various treatment and practice settings. The seminar format facilitates individual learning and promotes a learning to practice, reflective approach. The seminar assumes there are numerous evidenced-based models and practices and focuses student learning on the role of the professional use of self in the implementation of theory, technique, model, or intervention. Prereq: SASS 583 or SASS 400-TR.

SASS 589. Advanced Social Work Practice In Integrated Healthcare. 3 Units.
The objective of this course is to introduce social work students to the direct practice of integrated behavioral health in primary care settings. Students will become knowledgeable of the roles of behavioral health providers working in healthcare settings, theories and models of care, and cross-cultural issues. They will develop skills in engagement, assessment, intervention, planning and implementation, and practice evaluation. Because the populations served in primary care settings span the continuum of severity in both the physical and behavioral health dimensions, students will develop competencies in engaging and supporting diverse patients across a range of health conditions. Prereq: SASS 477 or SASS 400-TR.

SASS 590. Field Practice. 1 - 12 Units.

SASS 594. Independent Study Abroad. 1 - 12 Units.
(Credit as arranged.)

SASS 598. Individual Reading. 1 - 12 Units.
Special written permission needed. See MSASS registrar.
SASS 601. Field Education I. 2 Units.
The overall goal of this course is to provide graduate level social work students with field related opportunities to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. The field instructor is based at the social service setting and provides the direct instruction of the student. The faculty advisor, who is based at the School, serves as a link between all parties, interprets the requirements and standards of the School, and participates and consults in the design of the student's learning experience. The field instructor assigns tasks to the student according to the requirements of the School and the educational and experiential level of the student. Student, field instructor, and faculty field advisor all participate in various ways in the evaluation of the student's work; the faculty advisor is responsible for assigning the grade.

SASS 602. Field Education II. 3 Units.
This course is designed to be taken by entering Advanced Standing students in the first semester of their master's program and by Foundation level social work students in the second semester of their master's program. It consists of a field practicum and participation in professional development opportunities. For students entering the program with advanced standing, there is an additional requirement of four logs and an integrative assignment, and periodic meetings with a field faculty advisor in addition to the field conference. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values, and ethics acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with an opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Students spend 336 hours in field and professional development in SASS 602. Prereq: SASS 601 or SASS 400-TR.

SASS 603. Field Education III. 3 Units.
The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop advanced level competencies in their area of concentration in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with an opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Students spend 336 hours in field and professional development in SASS 603. Prereq: SASS 602 or equivalent.

SASS 604. Field Education IV. 3 Units.
This course is designed to be taken by students in their advanced course of study. It consists of a field practicum and participation in professional development opportunities. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop advanced level competencies in their area of concentration in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with an opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Student, field instructor, and field faculty advisor all participate in the evaluation of the student's work; the faculty advisor is responsible for assigning the grade. Students spend 336 hours in field and professional development in SASS 604. Prereq: SASS 603 or equivalent.

SASS 608. Philosophy of Science and Theory Building. 3 Units.
This is a required foundation course. The nature of theory is examined. Inductive and deductive methods for knowledge building are reviewed. Course content draws from philosophy of science as well as empirical and phenomenological research.

SASS 609. Theories of Social Welfare and Social Justice. 3 Units.
This is a foundation course required for all students. Theories of social welfare and social justice are examined. Course content draws from moral philosophy, economics, political science, cultural anthropology, sociology, history, psychology, and social welfare theory and provides students with a broad orientation to the field of theoretical social welfare.

SASS 610. Theories of Human Behavior: Macro and Micro Dimensions. 3 Units.
This is a required foundation course. The nature of theory is examined. Inductive and deductive methods for knowledge building are reviewed. Course content draws from moral philosophy, economics, political science, cultural anthropology, sociology, history, psychology, and social welfare theory and provides students with a broad orientation to the field of theoretical social welfare.

SASS 611. Advanced Research Design. 3 Units.
This foundation course in research methods is required of all students. It is a prerequisite to the quantitative and qualitative courses. Topics covered include operationalization of variables, threats to validity, and experimental, quasi-experimental and non-experimental research design.

SASS 614. Models of Qualitative Research. 3 Units.
This required course introduces students to the principles, approaches, methods, and analytical techniques utilized when conducting qualitative research in the social sciences. Five models of qualitative research design and methodology are studied, including narrative analysis, case study, ethnography, and grounded theory and phenomenology. This course is designed to provide students with the tools to critically evaluate as well as to enhance the academic rigor of qualitative data. Prereq: SASS 608 and SASS 613.

SASS 615. Social Statistics and Data Analysis. 3 Units.
This foundation course (or its equivalent) is required of all students. Content includes univariate, bivariate and inferential statistics, and the use of electronic data processing technology to manage and analyze data. Prereq: SASS 613.
SASS 616. Applied Regression and the Linear Model. 3 Units.
This is a required course in the research methods sequence for MSASS doctoral students. At the end of this course, students will be able to apply ordinary least squares regression and logistic regression in the analysis of social science data. They will learn to formulate research questions and hypotheses, specify statistical models, carry out the appropriate analyses, interpret their findings, and communicate their results clearly and effectively. Prereq: SASS 613 and SASS 615.

SASS 617. Specialization Seminar. 3 Units.
This elective course is a graduate level seminar; students and instructors share in the responsibility for presenting information and constructive criticism on the material. Topics include the selection and description of a social welfare topic, the theoretical explanations of that topic and the development of a focused, empirically-based literature review resulting in research questions and hypothesis.

SASS 618. Measurement Issues in Quantitative Research. 3 Units.
This required course covers the operationalization of social science concepts and development of methods for their measurement. Issues covered include index and scale construction, validity, reliability, questionnaire design, factor analysis, measurement error, and missing data. Prereq: SASS 613, SASS 615 and SASS 616.

SASS 619. Structural Equation Modeling. 3 Units.
This advanced-level, elective statistics course focuses on the family of analytical techniques referred to as structural equation modeling (SEM). SEM covers both measurement models (e.g., confirmatory factor analysis) and structural models. The course covers theoretical and methodological considerations and preliminary data screening necessary to ascertain whether SEM would be an appropriate technique; terminology and notation specific to SEM; statistical assumptions and strategies for assessing and remedying possible violations; use of SEM to conduct confirmatory factor analysis; use of SEM to test structural models, including mediation models; advanced models (e.g., multiple-group, longitudinal, dyadic, to be determined by student interests); how to critique SEM analyses and identify common problems; statistical power; and best practices for reporting SEM analyses and results. AMOS will be used to conduct the SEM analyses and SPSS to conduct preliminary analyses. The course uses a combination of readings, class discussion, lecture, written assignments, and hands-on computer labs. Prereq: SASS 613, SASS 615, SASS 616 and SASS 618.

SASS 620. Intervention Research for Social Work Practice. 3 Units.
This course provides a critical overview of the major theories and the body of research informing contemporary social work practice. Theories will include the foundational, such as psychodynamic, ego-psychological, ecological and systems, along with trans-theoretical and post-modern theories. The course will integrate a discussion of the history of scientific inquiry in social work, particularly focusing on practice or intervention studies, systematic reviews and meta-analyses. Criteria for evaluating individual studies and the evidence base in specific practice areas will be included, along with material on the current state of Evidence-Based Practice. Recommended preparation: SASS 610.

SASS 621. Social Welfare Policy. 3 Units.
This course focuses on the critical review and application of policy analysis frameworks related to social welfare policy. The conceptual, historical, ideological, and political foundations contributing to the development, formulation, implementation, and monitoring and evaluation of social welfare policies will be critiqued. Social welfare policies intended to ameliorate social ills (e.g., poverty, education, housing) will be analyzed using policy analysis frameworks in a critical and comparative fashion. Policy alternatives to respond to current and future social problems will be critically discussed for feasibility, viability and economic effects. Recommended preparation: SASS 610.

SASS 622. Designing Mixed Methods Research. 3 Units.
This advanced doctoral-level seminar is designed to introduce students to the principles, methods, and analytical techniques utilized when conducting mixed methods research in social work and social welfare. The course is designed to provide substantive methodological content for various phases of the research process accompanied by experiential learning opportunities. The purpose of this course is to prepare students to select and implement mixed methods research designs that are appropriate and adequate for answering contemporary social work practice and social welfare policy research questions. Four domains of knowledge are addressed in the course: (1) the historical, philosophical and theoretical foundations of mixed methods research; (2) methods and strategies behind designing mixed methods research studies; (3) the major data collection techniques employed in mixed methods research; and (4) strategies for analyzing, interpreting and reporting mixed methods data. Six models of mixed methods research (convergent parallel design, explanatory sequential design, exploratory sequential design. Prereq: SASS 608, SASS 613, SASS 614 and SASS 615

SASS 630. Seminar on Social Work Education. 3 Units.
This required seminar examines the structure and content of social work education within the context of higher education in American society. Emphasis is placed on curriculum design and course development. The course also is designed to help students develop a strategic approach to teaching based on learning theory. Finally, attention is given to current issues and future directions for social work education.

SASS 631. Job Seekers Seminar. 3 Units.
This dynamically dated seminar is designed to prepare doctoral students for a successful academic job search. The course objectives include: Obtaining knowledge about where to find academic job postings and how to determine appropriate fit; understanding the job search process; developing application materials; practicing mock interviews and mock job talks; and, developing a strategy for a successful first year as a professor. Prereq: Advanced to Candidacy.

SASS 632. Research Project. 3 Units.
This elective course provides students with the opportunity to work with specific faculty engaged in research studies either on an individual or group basis. Prereq: 614 and SASS 615.

SASS 635. Advanced Quantitative Methods : Special Topics. 3 Units.
This course is designed to provide opportunities for doctoral students to learn advanced. cutting-edge quantitative methods. The course content will vary depending on the expertise of the instructor and education needs of the student. Possible topics might include structural equation modeling, multilevel modeling, longitudinal analysis (e.g., survival analysis, event history analysis),or meta-analysis. Course format (e.g., readings, seminar discussions, hands-on computer labs, number and frequency of class sessions) will be determined collaboratively by the instructor and students; however, the course is designed to be completed within one semester. Prereq: SASS 613, SASS 615, SASS 616, and SASS 618 or requisites not met permission.
SASS 637. Individual Reading. 1 - 18 Units.
This is an elective individual reading course permitting students to select areas of interest and pursue these interests with specific faculty.

SASS 651A. Field Education I-A. 1 Unit.
This course is designed to be taken by entering Non-Advanced Standing social work students in the first semester of their master's program. Students enrolled in SASS 651A take SASS 495, Field Education Seminar concurrently for the entire field period. The SASS 651A course is 16 weeks in duration. The overall goal of this course is to provide graduate level social work students with field related opportunities to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent developing practitioners. The field instructor is based at the social service setting and provides the direct instruction of the student. The faculty advisor, who is based at the School, serves as a link between all parties, interprets the requirements and standards of the School, and participates and consults in the design of the student's learning experience. The field instructor assigns tasks to the student according to the requirements of the School and the educational and experiential level of the student. Student, field instructor, and faculty field advisor all participate in various ways in the evaluation if student's work; the faculty advisor is responsible for assigning the grade. Students spend 75 hours in field and professional development in SASS 651A

SASS 651AV. Field Education I-AV. 1 Unit.
This course is designed to be taken by entering Non-Advanced Standing or foundation social work students after the successful completion of SASS495V of their master's program. The SASS 651AV course is 8 weeks in duration. The overall goal of this course is to provide graduate level social work students with field related opportunities to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent developing practitioners. The field instructor is based at the social service setting and provides the direct instruction of the student. The faculty advisor, who is based at the School, serves as a link between all parties, interprets the requirements and standards of the School, and participates and consults in the design of the student's learning experience. The field instructor assigns tasks to the student according to the requirements of the School and the educational and experiential level of the student. Student, field instructor, and faculty field advisor all participate in various ways in the evaluation if student's work; the faculty advisor is responsible for assigning the grade. Students spend 75 hours in field and professional development in SASS 651AV. Prereq: SASS 495V.

SASS 651B. Field Education I-B. 1 Unit.
This course is designed to be taken by entering Non-Advanced Standing social work students in the second semester of their master's program. The SASS 651B course is 16 weeks in duration. The overall goal of this course is to provide graduate level social work students with field related opportunities to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. The field instructor is based at the social service setting and provides the direct instruction of the student. The faculty advisor, who is based at the School, services as a link between all parties, interprets the requirements and standards of the School, and participates and consults in the design of the student's learning experiences. The field instructor assigns tasks to the student according to the requirement of the School and the educational and experiential level of the student. Student, field instructor, and faculty field advisor all participate in various ways in the evaluation of student's work; the faculty advisor is responsible for assigning the grade. Students spend 75 hours in field and professional development in SASS 651B. Prereq: SASS 651A.

SASS 651BV. Field Education I-BV. 1 Unit.
This course is designed to be taken by entering Non-Advanced Standing social work students in the second semester of their master's program. The SASS 651BV course is 8 weeks in duration. The overall goal of this course is to provide graduate level social work students with field related opportunities to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. The field instructor is based at the social service setting and provides the direct instruction of the student. The faculty advisor, who is based at the School, services as a link between all parties, interprets the requirements and standards of the School, and participates and consults in the design of the student's learning experiences. The field instructor assigns tasks to the student according to the requirement of the School and the educational and experiential level of the student. Student, field instructor, and faculty field advisor all participate in various ways in the evaluation of student's work; the faculty advisor is responsible for assigning the grade. Students spend 75 hours in field and professional development in SASS 651BV. Prereq: SASS 651A.
SASS 652A. Field Education II-A. 1.5 Unit.
This course is designed to be taken by entering Advanced Standing students in the first semester of their master's program and by Non-Advanced Standing social work students in the third semester of their master's program. The SASS 652A course is 16 weeks in duration. It consists of a field practicum and participation in professional development opportunities. For students entering the program with advanced standing, there is an additional requirement of four logs and an integrative assignment, and periodic meetings with a field faculty advisor in addition to the field conference. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values, and ethics acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with an opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Students spend 150 hours in field and professional development in SASS 652A. Prereq: SASS 651A and SASS 651B or SASS 400-TR.

SASS 652B. Field Education II-B. 1.5 Unit.
This course is designed to be taken by entering Advanced Standing students in the second semesters of their master's program and by Non-Advanced Standing social work students in the fourth semester of their master's program. The SASS 652B course is 16 weeks in duration. It consists of a field practicum and participation in professional development opportunities. For students entering the program with advanced standing, there is an additional requirement of four logs and an integrative assignment, and periodic meetings with a field faculty advisor in addition to the field conference. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop foundation level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values, and ethics acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with an opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Students spend 150 hours in field and professional development in SASS 652B. Prereq: SASS 652A.

SASS 653A. Field Education III-A. 1.5 Unit.
This course is designed to be taken by students in their advanced course of study. Advanced Standing social work students take this course in the third semester of their master's program. Non-Advanced Standing social work students take it in the fifth semester of their master's program. The SASS 653A course is 16 weeks in duration. It consists of a field practicum and participation in professional development opportunities. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop advanced level competencies in their area of concentration in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with a forum to develop social work skills, opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Students spend 150 hours in field and professional development in SASS 653A. Prereq: SASS 652A and SASS 652B.

SASS 653B. Field Education III-B. 1.5 Unit.
This course is designed to be taken by students in their advanced course of study. Advanced Standing social work students take this course in the fourth semester of their master's program. Non-Advanced Standing social work students take it in the sixth semester of their master's program. The SASS 653B course is 16 weeks in duration. It consists of a field practicum and participation in professional development opportunities. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop advanced level competencies in their area of concentration in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with a forum to develop social work skills, opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Students spend 150 hours in field and professional development in SASS 653B. Prereq: SASS 653A.
SASS 654A. Field Education IV-A. 1.5 Unit.
This course is designed to be taken by students in their advanced course of study. Advanced Standing social work students take this course in the fifth semester of their master's program. Non-Advanced Standing social work students take it in the seventh semester of their master's program. The SASS 654A course is 16 weeks in duration. It consists of a field practicum and participation in professional development opportunities. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop their advanced level competencies in their area of concentration in the eight abilities by helping students apply ethic acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with an opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Student, field instructor, and field faculty advisor all participate in the evaluation of the student's work; the faculty advisor is responsible for assigning the grade. Students spend 150 hours in field and professional development in SASS 654A. Prereq: SASS 653A and SASS 653B.

SASS 654B. Field Education IV-B. 1.5 Unit.
This course is designed to be taken by students in their advanced course of study. Advanced Standing social work students take this course in the sixth semester of their master's program. Non-Advanced Standing social work students take it in the eighth semester of their master's program. The SASS 654B course is 16 weeks in duration. It consists of a field practicum and participation in professional development opportunities. The overall goal of this course is to provide graduate level social work students with field related opportunities to continue to develop their advanced level competencies in their area of concentration in the eight abilities by helping students apply ethic acquired in the classroom in an agency setting. The periodic meetings with the field faculty advisor are designed to provide students with an opportunity to integrate classroom and field learning. These collective experiences provide students with a forum to develop social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent, developing practitioners. Student, field instructor, and field faculty advisor all participate in the evaluation of the student's work; the faculty advisor is responsible for assigning the grade. Students spend 150 hours in field and professional development in SASS 654B. Prereq: SASS 654A.

SASS 655. Dual Degree Field Practicum II. 3 Units.
This course is designed to be taken by MSSA/MPH joint degree students as the second field period of their master's program. It consists of a field practicum and participation in professional development opportunities. The Field Practicum is an integral component of the MSASS and MPH curriculums, allowing students to apply, develop, and refine their conceptual knowledge and skills as part of a planned, supervised, and evaluated community-based experience. The Practicum is designed to move students beyond the walls of academia, to understand the political, economic, social, and organizational contexts within which social work and public health activities are conducted. These collective experiences provide students with a forum to develop skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent developing practitioners. (EPAAS Program Objective M6 and EPAAS Content Area 4.7) The overall goal of this course is to provide graduate level MSSA/MPH joint degree students with field related opportunities to continue to develop foundation level competencies in the eight MSSAS abilities by helping students apply knowledge of social work and public health theory, skills, values and ethics acquired in the classroom in an agency setting. Offered as MPHP 655 and SASS 655. Prereq: SASS 601.

SASS 656. Dual Degree Field Capstone III. 3 Units.
The Public Health Capstone Project is an integral component of the MPH curriculum, allowing students to apply, develop, and refine their conceptual knowledge and skills as part of a planned, mentored, and evaluated public health scholarly project. This course is designed to be taken by advanced level students. It consists of a 288 hour field based Capstone experience and participation in 12 hours of professional development opportunities. The overall goal of this course is designed to move students beyond the walls and constraints of the classroom, to understand the political, economic, social, and organizational contexts within which public health and social work activities are conducted. It is also designed to provide graduate level dual degree students with field related opportunities to begin to develop advanced level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. These collective experiences provide students with a forum to continue to develop and hone social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent developing practitioners. (EPAAS Program Objective M6 and EPAAS Content Area 4.7) Offered as SASS 656 and MPH 656. Prereq: SASS 655.

SASS 657. Dual Degree Field Capstone IV. 3 Units.
The Public Health Capstone Project is an integral component of the MPH curriculum, allowing students to apply, develop, and refine their conceptual knowledge and skills as part of a planned, mentored, and evaluated public health scholarly project. This course is designed to be taken by advanced level students. It consists of a 288 hour field based Capstone experience and participation in 12 hours of professional development opportunities. The overall goal of this course is designed to move students beyond the walls and constraints of the classroom, to understand the political, economic, social, and organizational contexts within which public health and social work activities are conducted. It is also designed to provide graduate level dual degree students with field related opportunities to begin to develop advanced level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. Offered as MPHP 657 and SASS 657. Prereq: SASS 656 or MPH 656.
SASS 701. Dissertation Ph.D. 1 - 9 Units.
This course is intended for students who have passed the qualifying examination and are actively working on their dissertation. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.
SCHOOL OF DENTAL MEDICINE

The Case Western Reserve University School of Dental Medicine (http://dental.case.edu) is a professional school offering a curriculum leading to the Doctor of Dental Medicine degree (DMD). Advanced education programs in the dental specialties are also available.

The School of Dental Medicine was organized June 21, 1892, as the Dental Department of Western Reserve University. For the first 25 years of its existence, the school was located in downtown Cleveland. In 1917, the School of Dental Medicine became an integral part of the university and now occupies a building adjacent to the School of Medicine, the School of Nursing, and University Hospitals of Cleveland. In 2003, the name of the school officially changed from the School of Dental Surgery to the School of Dental Medicine, and the degree offered changed from Doctor of Dental Surgery to Doctor of Dental Medicine. Since its organization, it has conferred degrees on approximately 4,900 graduates.

The Profession of Dentistry

The mission of dentistry is the protection and improvement of the health of individuals and society with a concentration on oral health. Professional activities encompass a wide variety of endeavors including the clinical care of individuals, the prevention of disease, the discovery of new knowledge, and the development of procedures and policies that protect and improve health, especially for those populations at risk for disease.

Because oral health is an important concern of society, the role of the dentist continues to be essential and rewarding. Men and women who are interested in scientific studies directly related to the welfare of people should find a strong appeal in dentistry as a life work. It offers an unusual opportunity for public service, community respect, and the use of originality, compassion, and substantial skill and independent judgment on a daily basis.

Mission Statement

The mission of the Case Western Reserve University School of Dental Medicine is to provide outstanding programs in oral health education, patient care, focused research and scholarship, and service that are of value to our constituents. We will accomplish this in an environment which fosters collegiality and professionalism, and that enables a diverse group of students to become competent practitioners of dentistry and contribute to the health and well-being of individuals and communities.

Dental Education Program

The students who enter the School of Dental Medicine are very carefully selected and have already had many opportunities for intellectual and social development. The years in dental school should permit the continued maturation of the individual and should emphasize the basic knowledge and skills which are common to all dentists. Graduates should continue their dental education during their professional careers and add to the basic concepts taught in dental school by studying the scientific literature and by attending continuing education courses. While in dental school, the student develops an attitude of professionalism and a sense of responsibility toward the patient’s welfare, which will provide optimal dental care.

License to Practice Dentistry in Ohio

Specific information about licensure in Ohio and other states should be obtained from the individual state boards of dentistry.

Accreditation

The School of Dental Medicine is an institutional member of the American Dental Education Association and the programs of the School of Dental Medicine are accredited by the Commission on Dental Accreditation.

Facilities

The entire Health Sciences Center has been designed so that students can travel from the School of Dental Medicine to the School of Medicine, the School of Nursing, the Health Sciences Library, and any component of University Hospitals without having to go outside.

The dental school building was designed to provide a modern teaching facility. The Multimedia Laboratories are designed and equipped so that the basic sciences (except for anatomy), technique and simulated clinical experience can be carried on by the student in his or her individual area. The 50,000 square foot dental clinic floor consists of two major clinical areas and five specialty clinics. The major clinics are made up of individual cubicles, fully equipped as private operatories. Each student clinician is assigned to one of the individual operatories for the academic year.

Drawing from a local population of more than one million, the clinics provide a broad spectrum of care to the population, affording the student substantial clinical experience. The school cooperates with various organizations of the city in caring for their clients, an arrangement that provides additional clinical experience for students.

Libraries

The Cleveland Health Sciences Library (CHSL) was formed in 1966 by an agreement between the Cleveland Medical Library Association (CMLA) and Western Reserve University. CHSL operates in two locations: the Allen Memorial Medical Library and the Health Center Library (HCL).

The Allen collection, strongly clinical, serves private and institutional members of the Cleveland Medical Library Association as well as faculty and students of Case Western Reserve University.

The Health Center Library collection of basic science materials is primarily for faculty and students of the schools of dental medicine, medicine, and nursing and the department of biology.

The Dittrick Museum of Medical History, located on the third floor of the Allen Library, contains nearly 20,000 objects related to the history of medicine, dentistry, and pharmacy, with special emphasis on Cleveland and the Western Reserve. The museum also contains a medical archives collection and a rare book room.

Reference staff in both libraries help and instruct patrons in the use of the library and its bibliographic resources. Items not available on campus may be obtained through inter-library loan. Other services provided are quick telephone reference, citation verification, computerized or manual bibliographic searches, access to the internet, and online searching of a multitude of databases.

Hospital Affiliations

The School of Dental Medicine has working relationships with hospitals and health clinics in the Greater Cleveland community. Students have
the opportunity to function as dentists and observe hospital routine and operating room techniques in these hospitals. Many members of the faculty hold staff appointments in these extramural health facilities.

University Hospitals is a 974-bed tertiary care facility located across the street from the School of Dental Medicine. Graduate departments in oral and maxillofacial surgery and pediatric dentistry are based at this facility.

**Community Health Clinics**

Dental students participate in clinical care at several community health clinics in and around the greater Cleveland area. As part of the curriculum, dental students spend two weeks at one of the community clinics and additionally may volunteer their services in their free time.

**Administration**

Kenneth B. Chance, Sr., DDS  
(Case Western Reserve University)  
Dean of the School of Dental Medicine

Dale A. Baur, DDS  
(Case Western Reserve University)  
Associate Dean of Graduate Studies; Associate Professor of Oral and Maxillofacial Surgery and Chair

Ronald L. Occhionero, DDS  
(Case Western Reserve University)  
Associate Dean for Administration; Professor of Comprehensive Care

Sorin T. Teich, DMD, MBA  
(Hebrew University of Jerusalem Israel; Northwestern University-Chicago / Tel Aviv University-Israel)  
Associate Dean for Clinical Operations, Associate Professor of Comprehensive Care

Kristin Z. Victoroff, DDS (Dalhousie University), PhD (Case Western Reserve University)  
Associate Dean for Education, Associate Professor of Community Dentistry

Aaron Weinberg, DMD (The Hebrew University of Jerusalem), PhD (Israel)  
Associate Dean for Research, Professor of Biological Sciences and Chair

Fady F. Faddoul, DDS, MSD  
(Case Western Reserve University)  
Assistant Dean of Clinical Education; Interim Chair and Professor of Comprehensive Care

Suchitra S. Nelson, PhD  
(Case Western Reserve University)  
Assistant Dean, Clinical and Translational Research; Professor of Community Dentistry

John W. Smolik, MBA, CPA  
(Baldwin Wallace College)  
Assistant Dean of Finance, Operations and Information Technology

Kristin A. Williams, DDS, MPH  
(The Ohio State University; Case Western Reserve University)  
Assistant Dean for Admissions and Student Affairs, Assistant Professor of Community Dentistry, Director of Diversity, Equity and Inclusion

Paul Wolansky, BS, MS  
(Baldwin-Wallace College; Bowling Green State University)  
Assistant Dean of Development and Alumni Relations

Philip C. Aftoora, BS, MA  
(University of Dayton; Case Western Reserve University)  
Director of Student Services

Emil T. Chuck, BSE, PhD  
(Duke University; Case Western Reserve University)  
Director of Admissions

**Doctor of Dental Medicine (DMD)**

The program will accomplish its goals through academic work in four themes and two threads, which are woven throughout the four years of the program. The program includes a variety of educational formats to deliver the curricula, including problem-based learning sessions, team-based learning, independent study, seminars, experiential learning opportunities, traditional lectures, laboratories, standardized patient experiences, and patient-based comprehensive care. An important goal of the curriculum is to help students become better prepared in independent learning, critical thinking skills, and the use of evidence. The curriculum includes the following themes and threads:

**Themes**

**Health and Well-Being**

This theme contains all curricula – both didactic and clinical – that apply to health and the normal structure and functioning of the body and of the oral complex. The traditional content areas of physiology, biochemistry, anatomy, histology, among other dental science classes, are integrated through cases to form a better bridge between the basic sciences and the clinical sciences.

**Disease Processes**

The Disease Processes theme includes content related to general and oral diseases. These topics are often melded with healthy structure and function content to provide students with a global perspective of the implications of disease on usual functioning.

**Restoration of Health**

This theme contains content related to therapies necessary for treatment of medical disease and dental disease. A focus on restoring oral health is accomplished through virtual reality clinical skills training, training on models and progression to comprehensive dental care in conjunction with didactic knowledge.

**Maintenance of Health**

The Maintenance of Health theme focuses on curriculum which explores strategies for preserving health through general and oral health therapies, patient education, disease risk assessment, and disease prevention. This theme provides viewpoint from which students can develop life-long care plans for their patients.

**Threads**

**Inquiry**

This thread that runs throughout the four-year program supports student growth in skills in clinical decision making. Students develop an understanding of what scientific evidence is, how to make clinical decisions, and to value scientific discovery in all aspects of dentistry.

**Leadership**

This thread contains curriculum for the development of students as ethical, sensitive, caring practitioners who are stewards of oral health of the individual patient, the community, and society. An important focus in Leadership curriculum is content that helps students advance in their role
as a professional. It also supports the integration of all students into the practice management curriculum centered within their clinical preceptor groups.

**Years**

**Year 1**
This year includes curriculum describing normal healthy functioning and disease processes. Basic science content is taught in the context of clinical cases. Foundational work in understanding human structure and function is paired with learning about disease. Dental clinical sciences study the foundational elements of oral health.

**Year 2**
This year continues with an integrated approach to curricula in health and disease with an emphasis on the development of dental clinical skills. Further development of students as clinicians proceeds with their involvement in the clinical preceptor groups. Students will make a transition to increasing patient-centered clinical care as they demonstrate competency in clinical skills and didactic knowledge.

**Year 3**
This year includes didactic work related to advancing levels of knowledge and clinical experience. Students spend time in didactic classes that are directly related to clinical practice and in rotations to specialty clinical areas while accomplishing comprehensive patient care.

**Year 4**
Students gain clinical experience in the Comprehensive Care Clinics and finish didactic work which may include enrichment courses. They participate in practice management activities of their preceptor group, developing critical skills for general practice dentistry.

### Doctor of Dental Medicine (DMD)

#### First Year Courses

<table>
<thead>
<tr>
<th>Term</th>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Term</td>
<td>DSPR 136</td>
<td>Cariology</td>
</tr>
<tr>
<td></td>
<td>HEWB 121</td>
<td>Foundations of Life Science</td>
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<tr>
<td></td>
<td>HEWP 130</td>
<td>Oral Histology</td>
</tr>
<tr>
<td></td>
<td>HWDP 131</td>
<td>Heart and Lungs in Health and Disease</td>
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<tr>
<td></td>
<td>LDRS 100</td>
<td>Introduction to Interprofessional Education and Collaboration (graded in the spring)</td>
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<td>LDRS 111</td>
<td>Epidemiology for Public Health and Clinical Practice</td>
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<td></td>
<td>MAHE 141</td>
<td>Preventive Periodontics</td>
</tr>
<tr>
<td></td>
<td>MAHE 144</td>
<td>Preventive Periodontics Clinic (graded in the spring)</td>
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<tr>
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<td>MAHE 145</td>
<td>ACE: Outreach Preventive Dentistry</td>
</tr>
<tr>
<td></td>
<td>REHE 151</td>
<td>Dental Anatomy</td>
</tr>
<tr>
<td></td>
<td>REHE 153</td>
<td>Dental Anatomy Laboratory</td>
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</table>

| Second Term           | DSPR 123    | Facial Growth                        |
|                       | HEWP 124    | Masticatory Dynamics                 |
|                       | HEWP 126    | Masticatory Dynamics Lab             |
|                       | HEWP 128    | Body as Host                         |
|                       | HEWP 134    | Head and Neck Structure and Function |

| Second Term           | INQU 102    | ACE: Knowing the Patient             |
|                       | LDRS 100    | Introduction to Interprofessional Education and Collaboration |
|                       | LDRS 116    | Promoting Evidence-based Dentistry I |
|                       | MAHE 144    | Preventive Periodontics Clinic       |
|                       | MAHE 147    | ACE Clinical Outreach Preventive Dentistry |
|                       | REHE 152    | Basic Procedures in Fixed Prosthetics |
|                       | REHE 154    | Basic Procedures in Fixed Prosthetics Lab |
|                       | REHE 158    | Dental Materials I                   |
|                       | REHE 162    | Basic Procedures in Operative Dentistry I |
|                       | REHE 172    | Basic Procedures in Operative Dentistry I Lab |

<table>
<thead>
<tr>
<th>HEWP Foundations of Life Science</th>
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<tbody>
<tr>
<td>Total Units</td>
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#### Second Year Courses

<table>
<thead>
<tr>
<th>Term</th>
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<tbody>
<tr>
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<td>DSPR 239</td>
<td>Neoplasia</td>
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<td>HWDP 232</td>
<td>Renal and Hematologic Systems in Health and Disease</td>
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<td>HWDP 241</td>
<td>Gastrointestinal System in Health and Disease</td>
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<td>HWDP 243</td>
<td>Endocrine and Reproductive Systems in Health and Disease</td>
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<td>HWDP 245</td>
<td>Musculoskeletal System in Health and Disease</td>
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<td>HWDP 246</td>
<td>Neuroscience in Health and Disease</td>
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<td>MAHE 242</td>
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<td>REHE 229</td>
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<td></td>
<td>REHE 257</td>
<td>Prosthodontic Technology</td>
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<tr>
<td></td>
<td>REHE 259-1</td>
<td>Basic Procedures in Fixed Prosthodontics II</td>
</tr>
<tr>
<td></td>
<td>REHE 260-1</td>
<td>Basic Procedure Fixed Prosthodontics II Lab</td>
</tr>
<tr>
<td></td>
<td>REHE 262</td>
<td>Basic Procedures in Operative Dentistry II</td>
</tr>
<tr>
<td></td>
<td>REHE 272</td>
<td>Basic Procedures in Operative Dentistry II Lab</td>
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<tr>
<td></td>
<td>REHE 267</td>
<td>Prosthodontic Technology Lab</td>
</tr>
<tr>
<td></td>
<td>REMA 261</td>
<td>Preclinical Orthodontics</td>
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</table>

| Second Term           | DSPR 232    | Periodontics                         |
|                       | DSPR 234    | Oral and Maxillofacial Pathology     |
|                       | DSPR 244    | Principles of Medicine               |
|                       | MAHE 214    | ACE: Family First                    |
|                       | MAHE 242    | Periodontics                         |
|                       | REHE 252    | Pain Control                         |
|                       | REHE 253    | Basic Procedures in Esthetics        |
|                       | REHE 254    | Pharmacology                         |
|                       | REHE 256    | Radiologic Interpretation            |
### Third Year Courses

#### Summer Term

<table>
<thead>
<tr>
<th>Course Code</th>
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<tr>
<td>DSPR 333</td>
<td>Management of Medical Emergencies</td>
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<tr>
<td>DSRE 335</td>
<td>Clinical Pharmacology</td>
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<tr>
<td>DSRE 395</td>
<td>Introduction to Oral and Maxillofacial Surgery</td>
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<tr>
<td>HEWB 349</td>
<td>Dentofacial Morphology</td>
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<tr>
<td>LDRS 313</td>
<td>Dental Patient Management/Risk Management</td>
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<tr>
<td>REHE 358</td>
<td>Dental Materials II</td>
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<tr>
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<tbody>
<tr>
<td>COMP 387</td>
<td>General Practice Dentistry A</td>
</tr>
<tr>
<td>COMP 389</td>
<td>General Practice Dentistry B</td>
</tr>
<tr>
<td>DSPR 341</td>
<td>Oral Diagnosis and Radiology</td>
</tr>
<tr>
<td>DSRE 391</td>
<td>Endodontics</td>
</tr>
<tr>
<td>DSRE 393</td>
<td>Principles of Oral and Maxillofacial Surgery I</td>
</tr>
<tr>
<td>DSRE 397-1</td>
<td>Temporomandibular Disorders and Occlusion</td>
</tr>
<tr>
<td>LDRS 317</td>
<td>Dental Auxiliary Management</td>
</tr>
<tr>
<td>REHE 351</td>
<td>Surgical Periodontics</td>
</tr>
<tr>
<td>REHE 353</td>
<td>Principles of Treatment Planning II</td>
</tr>
<tr>
<td>REHE 355</td>
<td>Esthetic Dentistry</td>
</tr>
<tr>
<td>REHE 360</td>
<td>Implant Dentistry</td>
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</table>

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>COMP 390</td>
<td>General Practice Dentistry A</td>
</tr>
<tr>
<td>COMP 394</td>
<td>General Practice Dentistry B</td>
</tr>
<tr>
<td>DSPR 342</td>
<td>Oral Cancer Diagnosis</td>
</tr>
<tr>
<td>DSRE 370</td>
<td>Principles of Oral and Maxillofacial Surgery II</td>
</tr>
<tr>
<td>DSRE 374</td>
<td>Fixed Prosthodontics</td>
</tr>
<tr>
<td>DSRE 392</td>
<td>Nitrous Oxide and Conscious Sedation</td>
</tr>
<tr>
<td>DSRE 397-2</td>
<td>Temporomandibular Disorders and Occlusion</td>
</tr>
<tr>
<td>LDRS 310</td>
<td>Professional Development</td>
</tr>
<tr>
<td>LDRS 316</td>
<td>Practice Management I</td>
</tr>
<tr>
<td>MAHE 340</td>
<td>Nutrition for Dentistry</td>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>REHE 258</td>
<td>Principles of Treatment Planning I</td>
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<tr>
<td>REHE 259-2</td>
<td>Basic Procedures in Fixed Prosthodontics II</td>
</tr>
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<td>REHE 260-2</td>
<td>Basic Procedure Fixed Prosthodontics II Lab</td>
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<tr>
<td>REHE 263</td>
<td>Basic Procedure in Esthetics Lab</td>
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<tr>
<td>REHE 264</td>
<td>Endodontics</td>
</tr>
<tr>
<td>REHE 266</td>
<td>Partial Denture Design</td>
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<td>REHE 276</td>
<td>Partial Denture Design Lab</td>
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<td>REHE 268</td>
<td>Basic Procedures Competency</td>
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<tr>
<td>REMA 270</td>
<td>Introduction to Pediatrics</td>
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**Total Units:** 0

### Fourth Year Courses

#### Summer Term

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<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>COMP 322</td>
<td>Surgical Periodontics</td>
</tr>
<tr>
<td>COMP 328</td>
<td>Oral Diagnosis and Treatment Planning</td>
</tr>
<tr>
<td>COMP 348</td>
<td>Endodontics</td>
</tr>
<tr>
<td>COMP 358</td>
<td>Clinical Oral Surgery I</td>
</tr>
<tr>
<td>COMP 378</td>
<td>Pediatric Dentistry Clinic</td>
</tr>
<tr>
<td>COMP 384</td>
<td>General Dentistry Clinical Qualifying</td>
</tr>
<tr>
<td>COMP 386</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>LDRS 415</td>
<td>Practice Management II</td>
</tr>
<tr>
<td>REHE 413</td>
<td>Advanced Implant Dentistry I</td>
</tr>
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</table>

#### First Term

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>COMP 417</td>
<td>Community Oral Health Capstone Experience (graded in the spring)</td>
</tr>
<tr>
<td>COMP 422</td>
<td>Periodontics (graded in the spring)</td>
</tr>
<tr>
<td>COMP 428</td>
<td>Oral Diagnosis and Radiology (graded in the spring)</td>
</tr>
<tr>
<td>COMP 448</td>
<td>Endodontics (graded in the spring)</td>
</tr>
<tr>
<td>COMP 458</td>
<td>Clinical Oral Surgery II (graded in the spring)</td>
</tr>
<tr>
<td>COMP 464</td>
<td>Operative Dentistry (graded in the spring)</td>
</tr>
<tr>
<td>COMP 468</td>
<td>Removable Prosthodontics (graded in the spring)</td>
</tr>
<tr>
<td>COMP 474</td>
<td>Fixed Prosthodontics (graded in the spring)</td>
</tr>
<tr>
<td>COMP 478</td>
<td>Pediatric Dentistry (graded in the spring)</td>
</tr>
<tr>
<td>COMP 480</td>
<td>Clinical Geriatric Dentistry (graded in the spring)</td>
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<tr>
<td>COMP 482</td>
<td>Clinical Orthodontics (graded in the spring)</td>
</tr>
<tr>
<td>COMP 487</td>
<td>General Practice Dentistry A</td>
</tr>
<tr>
<td>COMP 489</td>
<td>General Practice Dentistry B</td>
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<tr>
<td>COMP 492</td>
<td>General Dentistry Clinical Competency (Graded in Spring)</td>
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<tr>
<td>DSPR 426</td>
<td>Oral Diagnosis Seminar</td>
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<tr>
<td>LDRS 416</td>
<td>Practice Management III</td>
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<tr>
<td>LDRS 420</td>
<td>Jurisprudence and Professional Ethical Responsibility</td>
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<tr>
<td>REHE 400-1</td>
<td>Regional Board Preparation</td>
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<tr>
<td>REHE 421</td>
<td>Periodontal Medicine and Cases</td>
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<tr>
<td>REHE 455</td>
<td>General Anesthesia, Oral Surgery</td>
</tr>
<tr>
<td>REHE 482</td>
<td>Orthodontics</td>
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<tr>
<td>REHE 488</td>
<td>Case Presentations I</td>
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<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>COMP 417</td>
<td>Community Oral Health Capstone Experience</td>
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**Total Units:** 0
COMP 422  Periodontics  -
COMP 428  Oral Diagnosis and Radiology  -
COMP 448  Endodontics  -
COMP 458  Clinical Oral Surgery II  -
COMP 464  Operative Dentistry  -
COMP 468  Removable Prosthodontics  -
COMP 474  Fixed Prosthodontics  -
COMP 478  Pediatric Dentistry  -
COMP 480  Clinical Geriatric Dentistry  -
COMP 482  Clinical Orthodontics  -
COMP 490  General Practice Dentistry A  -
COMP 492  General Dentistry Clinical Competency  -
COMP 494  General Practice Dentistry B  -
COMP 498  Quality Assurance  -
REHE 400-2  Regional Board Preparation  -
REHE 414  Advanced Implant Dentistry II  -
REHE 489  Case Presentations II  -

Total Units: 0

**DMD/MS Clinical Research Training**

**Dual-Degree Program**

**This program is not currently accepting new students.**

The Case School of Dental Medicine, in collaboration with the School of Medicine, presents a dual-degree program made possible by the National Institute of Health (NIH) Ruth L. Kirschstein National Research Service (T32) Training Grant.

**Purpose**

The objective for the five-year joint DMD and Master in Clinical Research Training (DMD-MCRT) at the School of Dental Medicine is to train dental scholars for an academic career and for utilizing scientific advances to solve clinical problems. Part of this goal is training in clinical research so that the dental graduate may promote progress in biomedical research and develop innovative and effective strategies for the oral health needs of the population.

**Curriculum**

The DMD curriculum consists of 141.5 credit hours and the MCRT curriculum consists of 36 credit hours. The MCRT curriculum consists of 15 graded hours of core curriculum, 6 graded hours of DMD coursework, 3-6 graded hours of elective course(s), participation in a seminar series, and 9-12 graded hours of research work culminating in a thesis project. Components of the dental curriculum are equivalent to clinical research material that is taught at the graduate level. Thus a total of 6 credits will be applied from the dental curriculum to the master's degree.

A full year of research is a requirement. The student will be required to take one year off (either between the 2nd and 3rd or 3rd and 4th DMD years or immediately after DMD completion) for fulfillment of the master’s program. The one-year research training can also be accomplished in 2-3 month blocks between DMD years. A successful passing of the oral defense of the master’s research thesis is also required.

**Features**

Key features of this dual-degree program are that it is a five-year program where each student is assigned an advisor, a mentor, and the student will receive "protected time" to complete their master's requirements. This program will highlight core dental and master's courses as well as research rotations. The student will be required to complete a master's thesis research project and make a scientific presentation at the International Association of Dental Research or the American Association of Dental Research conferences.

**Admission**

Prospective students are eligible to apply to the program anytime after their first year of DMD studies, but prior to the start of the fourth DMD year. Applicants must complete an online application form that includes a personal statement describing the reason for seeking admission along with a summary of career goals and submit a non-refundable application fee, three sealed recommendation letters or online recommendation forms, a recent curriculum vitae including previous research experience, letters of support from training director and research mentor ensuring protected time, and official transcripts for all higher education degrees. Applicants will also be required to submit a photograph and Visa/Permanent Resident Card/ECFMG (if applicable). Admission to the program is contingent upon good DMD academic standing and recommendation letters from the Associate Dean for Education and the Director of the DMD-MCRT program.

**Master of Science in Clinical Research Sample Plan of Study**

**First Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Fall</th>
<th>Units</th>
<th>Spring</th>
<th>Summer</th>
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<td>MAHE 145</td>
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<td>CRSP 401</td>
<td>Introduction to Clinical Research Summer Series</td>
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<td>Statistical Science for Medical Research</td>
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<tr>
<td>CMED 403</td>
<td>Introduction to Clinical Epidemiology</td>
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<td>CRSP 603</td>
<td>Research Ethics and Regulation</td>
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<td>CRSP 501</td>
<td>Team Science - Working in Interdisciplinary Research Teams</td>
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<tr>
<td>CRSP 510</td>
<td>Health Disparities</td>
<td>3</td>
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<tr>
<td>CRSP 651</td>
<td>Clinical Research Scholars Thesis</td>
<td>1-18</td>
<td>1-2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Electives**

Can be selected from EPBI, CRSP or other university master level courses

3-6
The DMD curriculum consists of 141.5 credit hours and the MPH curriculum consists of 42 credit hours. The latter includes 29 credit hours of didactic MPH courses, 4 credits for DMD course work, participation in a seminar series, and 9 credit hours for the culminating experience. Of the 29 credit hours of didactic curriculum, 21 must be from core MPH courses. The nine hours of culminating experience includes 6 hours of a capstone project and 3 hours of a public health practicum. Dual degree students are required to enroll in electives as well, which would depend on their public health major. Information about the MPH program can be found here (p. 846)

Features
Each dual degree student will be assigned advisor(s) who will advise and guide them towards completing the program. In addition to didactic courses, the DMD-MPH program requires field experiences/rotations at extramural sites/clinics. The student will also be required to complete a capstone project and present the findings at the Innovations in Population Health Conference, the School of Dental Medicine Professional Day, and at a national conference.

Merits of a dual degree in Dental Medicine and Public Health
Dentistry and public health are inexorably linked; Increasing need for public health dentists; Enhanced preventive dentistry skills in the office settings with a focus on improving the oral health of people; Improved skills in health promotion and disease prevention through understanding of health behavior and health communication principles; Increased ability to apply public health principles to dental health of populations.

Careers
DMD-MPH program offers numerous career opportunities for its graduates, which include: Clinical Practice at Federally Qualified Community Health Centers, Local/County/State Health Departments; Indian Health Services, etc.; Administrative positions as dental directors of any of the agencies listed above; Research at teaching institutions, federal (e.g. NIH, CDC) and state/local public health agencies; insurance companies or dental industries; Faculty positions at dental schools or schools of public health.

Admission
Admission to the DMD program is required for consideration to the dual-degree program. Application protocol for the DMD program is at: https://dental.case.edu/admissions/dmd/apply/ Prospective students are eligible to apply to the MPH program any time before starting their third DMD year. Applicants must complete an online application for the MPH program (http://mph.case.edu/apply.html), which includes a personal statement about their interest in public health and professional goals; three letters of recommendation; GRE or DAT test scores, official transcripts for all higher education degrees, and TOEFL or IELTS if applicable.

Sample Template for Course Schedule for DMD/MPH (with MPH-dedicated year prior to DMD Year 1)

<table>
<thead>
<tr>
<th>Year 1, Fall (15 credits)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPH 406</td>
<td>History and Philosophy of Public Health *</td>
</tr>
<tr>
<td>MPH 483</td>
<td>Introduction to Epidemiology for Public Health Practice</td>
</tr>
<tr>
<td>MPH 411</td>
<td>Introduction to Health Behavior *</td>
</tr>
<tr>
<td>MPH 510</td>
<td>Health Disparities</td>
</tr>
</tbody>
</table>

DMD/MPH DMD and Master of Public Health

Dual-Degree Program
Doctor of Dental Medicine and Master of Public Health

The Case Western Reserve University offers a dual degree program in dental medicine and public health: Doctor of Dental Medicine and Master of Public Health (DMD-MPH). One of the five years of the dual degree program must be dedicated to MPH courses, which can be either before the first DMD year, between the 1st and 2nd DMD years, or between the 2nd and 3rd DMD years. Other possible options for the dedicated MPH year will be considered on a case-by-case basis.

Purpose
One of the primary goals of the American Dental Association (ADA) is to "Promote the oral health of the public". Dental public health is one of the nine recognized specialties of the ADA, and is defined as "the art and science of preventing oral diseases and promoting oral health through organized community efforts". The objective of the five-year dual degree program is to impart knowledge and skills necessary to expand the practice of dentistry into the community in a proactive way that fosters improved oral health, and as a direct result, yields improved overall health of the populations involved.

Curriculum
The DMD curriculum consists of 141.5 credit hours. The latter includes 29 credit hours of didactic MPH courses, 4 credits for DMD course work, participation in a seminar series, and 9 credit hours for the culminating experience. Of the 29 credit hours of didactic curriculum, 21 must be from core MPH courses. The nine hours of culminating experience includes 6 hours of a capstone project and 3 hours of a public health practicum. Dual degree students are required to enroll in electives as well, which would depend on their public health major. Information about the MPH program can be found here (p. 846)

Features
Each dual degree student will be assigned advisor(s) who will advise and guide them towards completing the program. In addition to didactic courses, the DMD-MPH program requires field experiences/rotations at extramural sites/clinics. The student will also be required to complete a capstone project and present the findings at the Innovations in Population Health Conference, the School of Dental Medicine Professional Day, and at a national conference.

Merits of a dual degree in Dental Medicine and Public Health
Dentistry and public health are inexorably linked; Increasing need for public health dentists; Enhanced preventive dentistry skills in the office settings with a focus on improving the oral health of people; Improved skills in health promotion and disease prevention through understanding of health behavior and health communication principles; Increased ability to apply public health principles to dental health of populations.

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Admission
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<td>Introduction to Health Behavior *</td>
</tr>
<tr>
<td>MPH 510</td>
<td>Health Disparities</td>
</tr>
</tbody>
</table>
DMD Special Programs for Undergraduates

The School of Dental Medicine offers a predental track for outstanding high school seniors who plan to pursue careers in dentistry.

Pre-Professional Scholars in Dentistry

The Pre-Professional Scholars Program in Dentistry offers exceptionally well-qualified high school students a seven-year program where students join the CWRU School of Dental Medicine after completing three years of undergraduate coursework. For more information about the program, see Pre-Professional Scholars Program (p. 1079) in the Office of Undergraduate Studies section of this bulletin. For more information about admission to the Pre-Professional Scholars Program, see the Office of Undergraduate Admission website (http://case.edu/admissions).

Senior Year in Professional Studies

The Senior Year in Professional Studies offers Case Western Reserve undergraduate students, who are candidates for the Bachelor of Arts (BA) degree and who are admitted to Case Western Reserve University School of Dental Medicine by the end of the junior year, the opportunity to shorten their entire course of studies by one year. For more information about the program and admission, see Acceleration Toward Professional Degrees (p. 1077) in the Office of Undergraduate Studies section of this bulletin.

Graduate Studies at School of Dental Medicine

Academic Regulations

Registration

Graduate studies programs operate on a twelve-month basis, from July 1 to June 30. The year is divided into two six-month semesters. The fall semester is from July 1 to December 31; spring semester is from January 1 to June 30. The act of registration includes submission of a course schedule approved by the department, the payment of semester tuition, and the dental school registrar registering the student. Each semester, registration must be completed as scheduled. Students enrolled in fall and spring semesters may arrange to pay bills for tuition and fees in two installments. At least half of the total bill must be paid at registration; the remainder must be paid in accordance with university policy. Fees may be charged for late registration or late payment. Students who fail to be registered within 30 days after the published dates will be considered to have withdrawn from the program. In the School of Dental Medicine, students who are not registered are not considered students of record, lose the protections of the university in matters of liability, and therefore, may not treat patients. They can no longer attend class or receive grades and will have to formally reestablish their matriculation. In any circumstance, all lost course and/or clinical time will be added to the end of the program’s original completion date.

Under unusual circumstances, special arrangements for registration may be made with permission of the department chair and the associate dean for graduate studies. Social security numbers are used for all records and documents and must be provided at the time of registration. Foreign students will be issued a number for this purpose if they have not obtained a social security number prior to registration. New students and new residents who are not registered as specified and who have failed to provide satisfactory reasons for the delay in advance will forfeit their right to admission. Vacancies which arise from such circumstances are filled from a list of alternate candidates at the discretion of the department.

Grading

The responsibility for assigning grades rests exclusively with the course director, who must announce the general method of grading at the beginning of the course. Course grades are reported to the registrar of the School of Dental Medicine at the end of the course or when a final grade has been determined, if prior to the scheduled completion time for the course. Incomplete or conditional grades can be changed only by the course director as described in the University Registrar (http://bulletin.case.edu/universityregistrar/#grading_systemtext) section of this bulletin. Grading in the School of Dental Medicine Graduate Programs is A, B, C, or F and pass/no pass.

Transfer Credit

Transfer of credit from another university is limited to six semester hours of graduate-level courses. Such transfer requires approval from the student’s advisor, the department chair, and the Office of Graduate Studies. Courses must have been taken within five years prior or subsequent to matriculation in the graduate program at Case Western Reserve University, and only those with grades of “B” or better are transferable. No credit for a thesis may be transferred from another university.

Graduate credit is not awarded for 100- or 200-level courses or their equivalents.

Thesis Advisory Committee

Each master’s degree candidate is advised to consult with their Program Director as to when and how to form a thesis committee. The Graduate department chair, in consultation with the Program Director, chooses a faculty member to serve as the primary thesis advisor. The primary thesis advisor will help identify other members of the faculty (at least two) to serve as secondary advisors and as members of the thesis committee. At least two members of the thesis committee must be from the department in which the student is enrolled, and one must be from another department. Additional membership is not restricted and may include persons from outside the university who have qualifications acceptable to the department chair. Members of the thesis committee continue in their capacity until the student graduates or leaves the program of study. The thesis committee will be responsible for guiding the student in the development of a thesis protocol. Once a protocol is acceptable, the thesis committee members advise the student on the conduct of the research and writing of the thesis document. Ultimately,
the committee members will evaluate the student's oral defense and final
thesis document.

Research Project
For master's degree programs, each student must carry out an original
and meaningful research project acceptable to the department chair and
the advisory committee. A written thesis, similarly acceptable, is to be
prepared and must conform to the standard format determined by the
Office of Graduate Studies of the School of Dental Medicine. The thesis
must be submitted before the prescribed deadline. An oral examination
(defense) of the thesis is required. This examination is administered by
the student's advisory committee before a standard date set by the Office
of Graduate Studies of the School of Dental Medicine. The Advisor and
all committee members must be present for the defense. Unanimous
agreement of the committee is required to pass the thesis examination. A
student must be registered for thesis credit or continuing graduate work
during the semester in which the thesis examination is conducted. The
thesis defense is ordinarily open to all members of the university faculty,
student body, and guests.

Extra Courses
Individual students enrolled in an advanced education program, whether
or not a master's degree is involved, may be required to take courses
beyond the general requirements set forth by the department in order to
complete the program. In such instances, the student must be notified in
writing by the department chair, with a copy filed in the Office of Graduate
Studies of the School of Dental Medicine.

Time Limits
Each student is expected to maintain continuous registration and all
requirements must be completed within five consecutive calendar
years immediately following matriculation as an advanced education
student, including approved periods of leave of absence. A student who
fails to complete the requirements within five years must be formally
readmitted with full standing in order to continue study, subject to terms
of readmission, future time limits, and revised requirements for the award
of the degree. Prior status in the program is no guarantee of readmission
and should not be assumed.

Leave of Absence
A student may request a leave of absence for personal reasons or
reasons of health when anticipated or actual absence is in excess of
three weeks. A written request for a leave of absence must include
the reason for the request and the length of time requested. A leave
of absence cannot exceed one calendar year. It must be submitted to
the program director and to the associate dean of graduate studies of
the School of Dental Medicine. The program director will forward the
request with his/her response to the Committee on Graduate Studies.
In order to be eligible for such requests, the student must be currently
enrolled and in regular attendance prior to the time or circumstances that
necessitated the request. At the expiration of the leave, the student must
resume registration unless formally granted an extension. A leave of
absence does not extend the maximum time permitted for the completion
of degree requirements. A student who fails to obtain an approved
leave, or who fails to resume registration at the time expected, may be
separated from the program. During the period of leave, it is expected that
the student will not avail himself or herself of the teaching and research
resources of the School of Dental Medicine or the university. At the end
of an approved leave, reentry into the program is reviewed by the program
director in concert with the Committee on Graduate Studies, and may not
be at the same level attained at the time the leave was granted. Programs
with a high patient case component may require that the clinical portion
of the program be repeated in its entirety. Finally, the committee also
reserves the right to place a student on leave of absence where it has
been determined that the circumstances warrant, even in the absence of
a formal request.

Maintenance of Good Standing
A minimum cumulative grade point average of 2.75 is required for good
standing in a graduate program for all courses taken for graduate credit
(excluding those graded Satisfactory/Unsatisfactory or Pass/No Pass).

The associate dean for graduate studies reviews student performance
and may recommend a course of action to the Committee on Graduate
Studies. The committee may require remedial work, place a student on
academic review or probation, set conditions for continuation in the
student's course of study or program, and may require withdrawal for
failure to meet the academic standards set by the department or school.
A student who receives a grade deemed unsatisfactory in any course is
placed on probation and must remove himself or herself from probation
within a time period specified by the committee. It is expected that
removal from probation will ordinarily require repetition of the course
with an acceptable grade or the successful completion of work deemed
equivalent by the student's advisory committee and the departmental
chair.

In this regard, a student may be separated from the university for any one
of the following reasons:

1. Failure to correct probationary status within the specified time period.
2. Failure to achieve a minimum grade point average of 2.50 or above
   upon completion of 12 semester hours or a grade point average of
   2.75 or higher upon completion of 21 semester hours of graduate
   study.
3. Failure to complete all requirements for the master's degree within
   five consecutive calendar years from the term of matriculation,
   unless granted an extension of a maximum of one year upon
   recommendation of the advisor and chair and approved by the
   associate dean for graduate studies.

In calculating the grade point average, all courses for which quality
points are given are counted, including courses which may be required
to be repeated. In addition, on the recommendation of the student's
department, and with due process, the School of Dental Medicine may
suspend or separate a student from the university for failure to maintain
appropriate standards of conduct and integrity in discharging their
responsibilities. Academic failure, moral delinquency, gross misconduct,
or failure to meet the specific conditions of probation or academic review
is sufficient reason for requiring withdrawal from the school.

Graduation
The minimum requirements for the master's degree in the School of
Dental Medicine are 36 semester hours of course work, including six
or more semester hours of thesis/equivalent registration, and the
submission of an accepted thesis. Individual departments may require
additional semester hours of specific course work and/or thesis. Not less
than 24 semester hours may be at the 500 level or higher.

A candidate for a Master of Science in Dentistry degree must make
application for the degree to the Office of Graduate Studies of the School
of Dental Medicine no later than three months before the commencement
at which the degree is expected.
Advanced Education in General Dentistry (AEGD)

The AEGD program is a one-year experience with a major emphasis in clinical general dentistry designed to provide the resident with training beyond what received in the pre-doctoral curriculum.

Formal courses, seminars and literature review, as well as one week of "on call" per month, enhance the resident's ability to handle dental and medical emergencies encountered in everyday practice.

The AEGD program provides the resident the opportunity to deliver the highest quality of comprehensive dental care to the broadest range of the population with a knowledge, comfort, and ease in treating the high risk patient and under-served segment of the population including: HIV/AIDS, medically compromised, physically handicapped, and geriatric populations with considerable experience in implantology and full mouth rehabilitation.

The AEGD program enables the resident to become proficient in diagnosis and treatment planning for the more challenging and complex cases to identify and treat many medical and/or dental emergencies encountered in every day dental practice. The AEGD program introduces the resident to the basic concepts of hospital dentistry and help them interact with their medical colleagues and other health care providers to integrate medical and dental care.

Goals and Objectives

- To provide the residents with the didactic knowledge and clinical experience to deliver multi disciplinary comprehensive oral health care to a wide range of the population beyond the level of predoctoral education. (This includes providing community services through the management of the medically and/or immunocompromised patient, the physically handicapped patient, as well as the geriatric and the under served segment of the population.)
- Enable the residents to identify and treat the most common medical and/or dental emergencies encountered in every day dental practice.
- To develop in the residents the values of professional ethics, and acceptance of cultural diversity in the practice of dentistry.
- To develop the skills of self evaluation and critical thinking.
- To provide the residents with experience to improve their ability to interact, function and communicate effectively with other health care professionals in the delivery of comprehensive treatment.
- To encourage the resident to continue the process of life long learning through continuing education, professional meetings, and review of literature.
- To provide the residents with training in patient, practice and risk management in order to manage a private dental practice.

Admission

Information about admission to the AEGD Program (http://dental.case.edu/aegd) can be found on the School of Dental Medicine website.

The didactic component of the AEGD program is conducted in both the formal courses as well as the departmental seminars.

Formal Courses

- Management of Medical Emergencies
- Pharmacology
- Orthodontic
- Interdisciplinary Seminars
- Occlusion
- Correlative Medical Sciences

Seminars

- Literature review
- Case Presentation
- Endodontics
- Periodontics
- Oral Surgery
- Implantology
- Oral Diagnosis and Treatment Planning
- Preventive Dentistry
- Pain and Anxiety Control in the Conscious Patient
- Geriatric Dentistry
- Special Care Patients including the Medically Compromised
- Aspesis and Infection Control
- Pediatric Dentistry
- Operative Dentistry
- Fixed and Removable Prosthodontics
- Oral Medicine
- Practice Management

Clinical Component and Rotations

<table>
<thead>
<tr>
<th>Month</th>
<th>Resident #1</th>
<th>Resident #1</th>
<th>Resident #3</th>
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<tbody>
<tr>
<td>August</td>
<td>Clinic - Geriatrics</td>
<td>Clinic</td>
<td>Clinic</td>
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<tr>
<td>September</td>
<td>Clinic - Geriatrics</td>
<td>Clinic - Pediatrics</td>
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<td>October</td>
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<td>Clinic - Pediatrics</td>
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<td>December</td>
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<td>January</td>
<td>Clinic</td>
<td>Clinic - Geriatrics</td>
<td>Clinic - Pediatrics</td>
</tr>
</tbody>
</table>
Plan of Study

**Service: Pediatric Rotation**
- Length of Rotation or Experience (in weeks): 12
- Number of Hours per week: 4

Objectives:
1. To provide residents with both clinical and didactic training in pediatric dentistry beyond that received in the pre-doctoral curriculum.
2. To improve the resident's ability in diagnosis, treatment planning, oral examination, and physical evaluation of the pediatric patient.
3. To improve the resident's ability to use non-pharmacologic management techniques to appropriately manage and guide the behavior of the child patient to accept needed treatment and to provide advice or guidance to the parent to enhance the child's acceptance.
4. To assist the resident in developing a working knowledge of preventive and corrective dental procedures relating to the growth and development of the stomatognathic system.
5. To increase both the confidence and competence of residents in meeting the general oral health needs of the pediatric patient.

**Service: Geriatric Dentistry**
- Length of Rotation or Experience (in weeks): 16
- Number of Hours per week: 8

Objectives:
1. See the variability of patient disability/ability/cognitive impairment in a diverse patient population.
2. Apply the principles of rational treatment planning to patients with limited access to dental care.
3. Practice behavioral management techniques for patients who are uncooperative.
4. Learn how to manage institutionalized patients and coordinate care with staff of the long-term care facilities.
5. Know how to deal with treatment of patients who cannot give informed consent.
6. Realize how much dental care is needed by older patients, and you will know what a significant positive impact that your work can have on the quality of life of older individuals.
7. Become a patient, empathetic caregiver.

**Behavioral Considerations in Oral Health Care**
(DENT 518)
- Units: 0 - 1

**Management of Medical Emergencies**
(DENT 555)
- Units: 0 - 1

**AEGD Residency Training**
(DENT 699)
- Units: 1 - 8

**Correlative Medical Science**
(DENT 502)
- Units: 0 - 2

**Multidisciplinary Seminar**
(DENT 698)
- Units: 0 - 2

**AEGD Residency Training**
(DENT 699)
- Units: 1 - 8

**Year Total:**
- Units: 1-11.5 - 1-10.5

**Total Units in Sequence:** 2-22

---

**Craniofacial, Surgical, and Special Care Orthodontics Fellowship Program**

Phone: 216.368.0673
Manish Valiathan, DDS, MSD, Program Director
manish.valiathan@case.edu

Fellows accepted into the Craniofacial, Surgical and Special Care Orthodontics Fellowship Program will be provided with advanced clinical, didactic, and research training during the 1 year program of study in the management of children with facial differences. We anticipate most fellows to go through a 1 year program of study. However, individuals who intend to devote the majority of their career in this area may be provided with the opportunity to enroll in a second year of study.

Graduates of the program will be exposed to the diagnoses, treatment planning, and clinical execution of orthodontic and dentofacial orthopedic services to a large clinical volume of pediatric, adolescent, and adult patients who have congenital and acquired craniofacial abnormalities. The goal of the Fellowship Program is to train the fellow to attain a level of competency that enables him or her to recognize, diagnosis and treat patients with craniofacial anomalies and special needs in a hospital-based, team care setting.

Fellows participate in the craniofacial and cleft conferences, review treatment plans and progress notes, and provide clinical care to the patients under direct supervision. All complex treatments are discussed with the attending on a case-by-case basis. New patient exams are done on a regular basis and the fellows work up cases (clinical exam, study models analysis, CBCT evaluations) and review the treatment plans with the attending on a case-by-case basis. New patient exams are done on a regular basis and the fellows work up cases.

Rotations with other services will form an integral part of the Fellowship Program. The principal rotations will be with the departments of plastic surgery, oral and maxillofacial surgery, and pediatric dentistry. In addition, the fellow will be exposed to speech pathology, pediatric otolaryngology, genetics, and occupational therapy.

The format of the program allows for constant one-on-one supervision that will allow for subjective assessments of the fellow's understanding of the subject matter, clinical skills, and patient management skills. This will be supplemented by weekly sessions with the faculty, where the fellow's understanding will be further tested. At the end of each semester,
a written examination will form part of the assessment of the fellow's progress.

**Admission**

More information about admission to the program can be obtained by contacting the following:

Manish Valiathan (manish.valiathan@case.edu), DDS, MSD, Program Director, at 216.368.0673; Deb Tomskiek (stephanie.leasure@case.edu), Craniofacial Clinic Assistant, at 216.368.4331; or Colleen Friday (colleen.friday@case.edu), Graduate Studies Administrator, at 216.368.1168

https://dental.case.edu/craniofacialortho/fellowships/

### Residency Program in Dental Public Health

The advanced education program in Dental Public Health is fully accredited by the Commission on Dental Accreditation and offers three tracks: 1) one-year full-time for dentists with a master's degree in public health or equivalent; 2) two-year part-time for dentists with a master's degree in public health or equivalent; and 3) two-year full-time for dentists WITHOUT a master's in public health. Residents in the first two tracks earn a certificate, while residents in the third track will earn a residency certificate from the School of Dental Medicine as well as an accredited MPH degree through Case Western Reserve University (CWRU) School of Medicine.

The primary training site is the CWRU School of Dental Medicine, with extramural sites in other parts of Ohio. The didactic instruction for the residency program encompasses competencies of the American Board for Dental Public Health and concepts such as population health, cultural competency, and health literacy. The field experience sites have been carefully chosen to increase residents' cultural sensitivity and understanding, particularly about underserved groups. Trainees have opportunities to work with indigent, homeless, and minority populations.

**Admission**

More information about admission to the dental public health residency program (http://dental.case.edu/community/residency/howtoapply) can be found on the School of Dental Medicine website.

### Endodontics

The graduate endodontics program is a continuous 24-month master's degree (Master of Science in Dentistry) and certificate program commencing the beginning of July each year. It has a full-time director and 5 part-time clinical faculty members. It is concerned with developing competent, skilled clinicians with teaching and research abilities.

To achieve these objectives, the program provides extensive background in both scientific and clinical knowledge. The curriculum is designed to fulfill the requirements of the American Board of Endodontics and promote Diplomates.

The program will prepare specialists in the fields of diagnosis, all phases of treatment and prevention of pulpal and periapical dental disease. It will provide training in research design and methodology as it relates to pulpal, dentinal, periodontal, and related clinical areas, preparing the resident for teaching responsibilities in undergraduate, postgraduate, and graduate levels.

A top of the line surgical microscope is required by the program for teaching a variety of microscopic surgery techniques.

The curriculum includes bone grafting, guided tissue regeneration and IV sedation.

Presentation of multiple table clinics is required.

### First Year

<table>
<thead>
<tr>
<th>Course Study</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Anatomy of the Head and Neck (DENT 513)</td>
<td>0 - 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multidisciplinary Seminar (DENT 698)</td>
<td>0 - .5</td>
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<td></td>
</tr>
<tr>
<td>Epidemiology and Biostatistics (DENT 510)</td>
<td>0 - 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioral Considerations in Oral Health Care (DENT 518)</td>
<td>0 - 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management of Medical Emergencies (DENT 555)</td>
<td>0 - 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Oral Pathology (DENT 512)</td>
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Oral and Facial Maxillofacial Surgery

The residency program at Case Western Reserve University in Oral and Maxillofacial Surgery is a joint program with the School of Medicine leading to an MD degree and certificate in oral and maxillofacial surgery. Case Western Reserve University is the only program in the country that enables residents to obtain their medical degree and certificate in five years.

Residents rotate through several institutions: the Department of Oral & Maxillofacial Surgery at University Hospitals of Cleveland, Cleveland’s Veterans Administration Hospital, the School of Dental Medicine at Case Western Reserve University, the Department of Oral and Maxillofacial Surgery at the Cleveland Clinic and the Cleveland Clinic Hospital. This diversity of institutions ensures that residents gain experience in the essential areas of clinical surgery in preparation for all types of practices.

Admission

More information about admission to the oral and maxillofacial surgery (http://dental.case.edu/omfs/residency/howtoapply) program can be found on the School of Dental Medicine website.

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Total Units in Sequence: 7-36.5

PGY 3

- University Hospitals/OMFS - 5 months
- The Cleveland Clinic/OMFS - 1 month
- Veteran’s Admin/OMFS - 1 month
- University Hospitals/Anesthesia - 3 months

PGY 4

General Surgery Internship:

- University Hospitals/OMFS - 2 months
- The Cleveland Clinic/OMFS - 1 month
- University Hospitals and MetroHealth/Surgery Rotations - 9 months
  - Plastic Surgery - 3 months
  - ENT - 2 months
  - Neurosurgery - 1 month
  - SICU/Trauma - 2 months
  - General Surgery/Pediatric Surgery - 1 month

PGY 5

- University Hospitals/OMFS Chief Resident - 6 months
- University Hospitals/OMFS - 6 months

Orthodontics

The graduate program in orthodontics is a master’s (Master of Science in Dentistry) and/or specialty certificate program dedicated to advancing the art and science of orthodontics through research, teaching, and service.

The clinical training of orthodontic residents encompasses all aspects of current orthodontic practice including, full treatment cases with bands and brackets, early treatment, adult treatment, craniofacial anomalies, orthognathic surgery, clear thermoplastic aligners, laser surgery and temporary anchorage devices (TADS). One of the strengths of this program is the clinical exposure during residency, with residents using a wide variety of techniques, and often having more than 75 patients under their care. The clinical outcome assessments in place help assure that the graduate is ready to become a competent orthodontist, and often all the patient cases required for board certification will be completed upon graduation. Since the 1930s, the Case Western Reserve University Orthodontic program has been a leader in craniofacial imaging beginning with the historic Bolton Brush Growth Study and continuing with cutting edge three dimensional imaging in our Craniofacial Imaging Center.

There is an option to extend the program to 36 months to satisfy European specialty training standards (ERASMUS).

Admission

More information about admission to the orthodontics program (http://dental.case.edu/orthodontics/grad/howtoapply) can be found on the School of Dental Medicine website.
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### Pediatric Dentistry

The graduate program in pediatric dentistry is a master’s (Master of Science in Dentistry) and certificate program that takes place at Case Western Reserve University School of Dental Medicine and Rainbow Babies and Children's Hospital.

The two-year post doctoral residency program follows closely the principles and policies as outlined in the Guidelines for Advanced Education in Pediatric Dentistry prepared by the American Academy of Pediatric Dentistry and the American Board of Pediatric Dentistry. It is fully accredited by the Commission on Dental Accreditation. Successful completion results in a certificate of specialty education in pediatric dentistry which qualifies the resident for examination by the American Board of Pediatric Dentistry.

Students who elect to complete the master’s program pay full tuition. The MSD program is open to non-US citizens and foreign-trained dentists. Foreign-trained dentists must complete a US GPR or AEGD before applying to the program.

Our purpose is to train the specialist as a qualified practitioner, consultant and advocate for complete dental treatment of healthy and special needs children.

The acquired skills prepare the pediatric dental resident to prevent, diagnose and treat common and unusual oral problems that might arise during the physical, psychological and emotional development of the child and adolescent. In addition to the oral aspects of childcare, the resident becomes cognizant of the general health problems related to children.

Our program offers a balanced clinical and didactic curriculum in advanced infant, child and adolescent dental care.

The pediatric dentistry curriculum is designed to have the resident play an integral role in the health care of children, side by side with his/her medical colleagues, and to prepare the resident for successful entry into the contemporary practice setting while providing the foundation for future growth in the field.

### Admission

More information about admission to the pediatric dentistry program (http://dental.case.edu/pediatrics/residency/howtoapply) can be found on the School of Dental Medicine website.

**The following courses are required for the postdoctoral student:**

- Behavioral Management
- Anatomy
- Epidemiology & Biostatistics
- Microbiology
- Facial Growth and Development
- Craniofacial Anomalies
- Hospital Dentistry
- Conscious Sedation
- Conferences
- Pediatric Dentistry Literature Review
• Preventive and Interceptive Orthodontics
• Genetics
• Pharmacology
• Hospital Rotations in the departments of Anesthesia, Pediatric, and Emergency Medicine

A research requirement must be fulfilled for certification in pediatric dentistry. Students enrolled in the MSD program must complete a formal thesis.

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### Periodontics

The graduate program in periodontics is a thirty-six month, continuous course of study, leading to both a certificate in Periodontics and a Master of Science in Dentistry degree. It is a fully accredited program by the American Dental Association, and meets all the clinical and didactic requirements of the American Board of Periodontology.

The general goals of the program are to train expert clinicians in this specialty, and/or to prepare individuals for an academic (research-teaching) career in Periodontics.

This postdoctoral program offers broad clinical experience and research training.
Completion and defense of a research thesis is one of the requirements of this program. Limited teaching experience is offered to the graduate student so that his/her exposure to clinical, research, and teaching facets of periodontics is complete. All of the faculty of the Department of Periodontics involved in teaching graduate students in this program are educationally or board certified periodontists. Additional instruction within this program is by faculty members of the School of Dental Medicine and the School of Medicine. Because of the multiplicity of training programs our professors have completed, the student is exposed to diverse views of diagnosis, prevention, and treatment of periodontal diseases. A brief initial review of basic aspects of periodontology introduces the new graduate student to the specialty training during the summer session. Extensive contact with practicing periodontists, sufficient exposure to hospital periodontal practice, and clinical training in dental implants are additional features of this program.

### Admission

More information about admission to the periodontics program (http://dental.case.edu/periodontics/residency/howtoapply) can be found on the School of Dental Medicine website.

The following courses are required for the postdoctoral student:

• Advanced Periodontal Seminar - ongoing for 3 years
• Literature Review in Periodontology- ongoing for 3 years
• Periodontal Conferences - ongoing for 3 years
• Clinical Periodontics- ongoing for 3 years
• Advanced Principles of Occlusion - 1 semester
• Conscious Sedation - 1 semester (didactic, 2nd year), ongoing for 2 years (clinical)
• Implant Dentistry - 1 semester (didactic, 2nd year), ongoing for 2 years (clinical)
• Research Thesis - ongoing for 2 year
• Periodontal Prosthesis - one semester
• Microbiology, Immunology and the Immune Response - 1 semester
• Management of Medical Emergencies - 1 summer session
• Anatomy of the Head and Neck - 1 summer session
• Limited Tooth Movement - 1 summer session
• Correlative Medical Science - 1 semester
• Introduction to Research Methods - one semester
• Advanced Oral Pathology - one semester
• Epidemiology and Biostatistics - 1 semester
• Interdisciplinary Seminar - one semester
• Clinical Pharmacology - one semester
• Creative Thinking in Research Development - 1 semester
• 2-week hospital rotation

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<td>Management of Medical Emergencies (DENT 555)</td>
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<tr>
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<tr>
<td>Clinical Periodontics (DPER 577)</td>
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<tr>
<td>Limited Tooth Movement for the Dental Specialist (DENT 586) (summer/fall)</td>
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<tr>
<td>Literature Review in Periodontics (DPER 685)</td>
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<tr>
<td>Biological Aspects of the Stomatological System (DENT 501)</td>
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<tr>
<td>Correlative Medical Science (DENT 502)</td>
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<tr>
<td>Research Methods: Preparation (DENT 514) (summer/fall)</td>
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<tr>
<td>Multidisciplinary Seminar (DENT 698)</td>
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<tr>
<td>Microbiology, Immunology, and Immune Systems (DENT 516)</td>
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<td>Behavioral Considerations in Oral Health Care (DENT 518)</td>
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<tr>
<td>Advanced Principles of Occlusion (DENT 564) (summer/fall - alternate years)</td>
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<td>Limited Tooth Movement for the Dental Specialist (DENT 586) (summer/fall)</td>
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<tr>
<td>Periodontal Prosthesis (DENT 587) (summer/fall)</td>
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<td>Hospital Rotation (DENT 588) (summer/fall)</td>
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<td>Thesis M.S.D. (DENT 651) (summer/fall)</td>
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<td>Conscious IV Sedation I (DENT 661) (summer)</td>
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| Total Units in Sequence:                                                               | 21-82.5 |

### Expanded Function Dental Auxiliary (EFDA)

The School of Dental Medicine offers a non-degree certificate course in expanded dental functions to dental auxiliaries with requisite training and experience. This continuing education program prepares the student to take an examination administered by the Ohio Commission on Dental Testing for Expanded Function Dental Auxiliaries.

The Expanded Function Dental Auxiliary course is a less than part-time program and includes didactic, pre-clinical laboratory, and clinical training. It is affiliated with several hospitals and health agencies in the Cleveland metropolitan area, where a portion of the clinical training takes place. Students are selected for admission on the basis of their performance on an entrance examination administered by the program faculty.

Upon successful completion of this accredited program, an auxiliary is eligible to sit for the state certifying examination provided by the Commission on Dental Testing in Ohio.

### Admission

Information about admission to the EFDA program (http://dental.case.edu/efda) can be found on the School of Dental Medicine website.

Students begin the program learning tooth anatomy, contour and contact using wax. Then students gradually advance through one, two, three, and complex surface restorations of amalgam and composite on the typodont. Rubber dam placement and sealant placement are also learned.

Part of the responsibility for being in the program will be for the employer dentist to allow the EFDA trainee to perform intra-oral procedures (restorations) in the office once the student has successfully passed semester one amalgam, composite, and sealant competencies.

Clinical/patient experience occurs during the second semester at MetroHealth Hospital/clinics, Case School of Dental Medicine Clinic, Rainbow Hospital Tapper Pedodontic Clinic, or St. Elizabeth Hospital Dental Clinic in Youngstown, Ohio, and the office in which the student is employed.

Mock board exams are given the second semester, simulating the testing atmosphere of the actual state examination.

After successful completion of the course, the student will be eligible to sit for the state board examination administered by the Commission on Dental Testing in Ohio (http://codtinohio.org) or by the Commission on Dental Competency Assessments. Examination candidates will be expected to bring their own instruments and materials (not school-owned) for the exam.
Here is the address for the CDCA hyperlink: http://www.cdcaexams.org/

According to various sections of the Ohio Law and Regulations for Certification and Licensure Boards, persons convicted of any felony or misdemeanor may not be able to take the licensure or certification examinations; may be refused acceptance of placement by the clinical/practicum sites; or may have restrictions placed on their ability to practice. For more information, contact the Dean of Student Services and the applicable licensure/certification board.

Lecture and lab during the first semester
• All day lab / clinic second semester
• An optional state board review course is offered at the end of the second semester, after completion of the EFDA Program in May for an additional fee

Lectures and labs
• Nomenclature
• Caries classification
• Cavity preparation
• Oral anatomy
• Dental morphology
• Periodontium
• Histology
• Basics of occlusion
• Ergonomics
• Instrumentation
• Pulp protection
• Dental materials
• Matrix and wedge techniques
• Temporization
• Amalgam placement and carving
• Polishing amalgams
• Composite placement
• Composite finishing and polishing
• Posterior composites
• Pit and fissure sealant placement
• Rubber dam placement

First Year

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<th>Course</th>
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Total Units in Sequence: 9.5

School of Dental Medicine Faculty
Full-time Faculty

Anita Aminoshariae, DDS, MS
(Case Western Reserve University; Virginia Commonwealth University)
Associate Professor of Endodontics

Hussein M. Assaf, DDS
(The Ohio State University)
Associate Professor of Comprehensive Care

Dale A. Baur, DDS
(Case Western Reserve University)
Associate Professor of Oral and Maxillofacial Surgery and Chair

Nabil F. Bissada, DDS, MSD, BDS
(Case Western Reserve University; University of Minnesota; University of Cairo)
Professor of Periodontics and Chair

Kenneth B. Chance, Sr., DDS
(Case Western Reserve University)
Dean of the School of Dental Medicine

Milda Chmieliauskaite, DMD, MPH
(University of Pennsylvania)
Assistant Professor of Oral and Maxillofacial Medicine and Diagnostic Sciences

Catherine Demko, PhD
(Case Western Reserve University)
Associate Professor of Community Dentistry

Fady F. Faddoul, DDS, MSD
(Case Western Reserve University)
Professor of Comprehensive Care and Interim Chair

Zhimin Feng, PhD
(Chinese Academy of Sciences)
Senior Instructor of Biological Sciences

Gerald A. Ferretti, DDS, MS, MPH
(Georgetown University; University of Connecticut; University of Kentucky)
Professor of Pediatric Dentistry and Chair

Margaret Ferretti, DMD
(Case Western Reserve University)
Assistant Professor

Steven W. Fox, DDS
(Case Western Reserve University)
Associate Professor of Comprehensive Care

Sharon Freudenberger, DDS
(New York University)
Associate Professor of Pediatric Dentistry

Jerold S. Goldberg, DDS
(Case Western Reserve University)
Professor of Oral and Maxillofacial Surgery
Santosh Ghosh, PhD
(Indian Institute of Technology, Kharagpur, India; MSc, North Bengal University, Siliguri, India)
Senior Research Associate Department of Biological Sciences

Angela R. Graves, DDS, MS
(Meharry Medical College; Columbia University)
Assistant Professor of Comprehensive Care

Mark G. Hans, DDS, MS
(Case Western Reserve University)
Professor of Orthodontics and Chair

Masahiro Heima, DDS, PhD
(Okayama University Japan)
Assistant Professor of Pediatric Dentistry

Alfredo Hernandez, DDS, MS
(Javeriana University Columbia; The Ohio State University)
Associate Professor of Comprehensive Care

Jean M. Iannadrea, DDS
(Case Western Reserve University)
Assistant Professor of Comprehensive Care and Oral and Maxillofacial Medicine and Diagnostic Sciences

T. Roma Jasinevicius, DDS, MEd
(Case Western Reserve University; Cleveland State University)
Associate Professor of Comprehensive Care

Ge Jin, PhD
(Case Western Reserve University)
Associate Professor of Biological Sciences

Zinaida Kaleinikova, DDS, MS, DMD
(Kaunas Medical University College of Odontology, Lithuania; The Ohio State University; Case Western Reserve University)
Associate Professor of Comprehensive Care

James A. Lalumandier, DDS, MPH
(Georgetown University; University of North Carolina)
Professor of Community Dentistry and Chair

Michael A. Landers, DDS, MA
(Case Western Reserve University; The Ohio State University)
Associate Professor of Oral and Maxillofacial Medicine and Diagnostic Sciences

Bruce Latimer, MA, PhD
(Case Western Reserve University; Kent State University)
Professor of Orthodontics

Charles J. Love, DDS
(Case Western Reserve University)
Associate Professor of Comprehensive Care

André K. Mickel, DDS, MSD
(Case Western Reserve University)
Associate Professor of Endodontics and Chair

Thomas A. Montagnese, DDS, MS
(The Ohio State University)
Assistant Professor of Endodontics

Sena Narendran, BDS, MS
(University of Ceylon Sri Lanka; University of London England)
Associate Professor of Community Dentistry

Suchitra S. Nelson, PhD
(Case Western Reserve University)
Professor of Community Dentistry; Assistant Dean, Clinical and Translational Research

Ronald L. Occhionero, DDS
(Case Western Reserve University)
Professor of Comprehensive Care; Associate Dean for Administration

Andre Paes B. da Silva, DDS, MSc, PhD
(Universidade Federal do Ceara, Brazil; University of Toronto)
Assistant Professor of Periodontics

MSc/Certificate in Periodontology from the University of North Carolina

Juan Martin Palomo, DDS, MSD
(Ponta Grossa State University Brazil; Case Western Reserve University)
Professor of Orthodontics

Leena Palomo, DDS, MSD
(Case Western Reserve University)
Associate Professor of Periodontics

Pushpa Pandiyan, PhD, MSc
(Humboldt University, Berlin Germany; Bharathidasan University, India)
Assistant Professor of Biological Sciences

Andres Pinto, DDS, DMS, MPH
(Universidad Javeriana, Colombia; University of Pennsylvania)
Professor of Oral and Maxillofacial Medicine and Diagnostic Sciences and Chair

Faisal A. Quereshy, DDS, MD
(State University of New York at Buffalo; Case Western Reserve University)
Associate Professor of Oral and Maxillofacial Surgery

Renato Roperto, DDS, MSc, PhD
(University of Ribeirão Preto; University of Sao Paulo; Sao Paulo State University, Brazil)
Associate Professor of Comprehensive Care

Benjamin L. Schechter, DDS
(Case Western Reserve University)
Assistant Professor of Comprehensive Care and Interim Assistant Dean for Clinical Education

Robert C. Skillicorn, DDS, MS
(Ohio State University; University of Michigan)
Associate Professor of Periodontics

Ivan Stojanov, DMD, MMSc
(Medical College of Georgia; Harvard School of Dental Medicine)
Assistant Professor of Oral and Maxillofacial Medicine and Diagnostic Sciences
COMP Courses

COMP 200. Directed Clinical Experience. .5 - 6 Units.
Directed clinical experience under faculty supervision and with special permission of the Associate Dean for Education.

COMP 300. Directed Clinical Studies. .5 - 8 Units.
Independent study during the period prior to daily clinic sessions, with emphasis on clinical didactic material and review of clinical procedures to support student’s clinical learning and progress. Meeting with clinical preceptors to review progress, to be initiated by the student as needed.

COMP 310. Summer Clinic. .5 - 6 Units.
Attendance is mandatory in the summer dental clinic of the third year. Students become acquainted with all aspects of clinical practice and begin providing clinical care for patients.

COMP 322. Surgical Periodontics. 1 Unit.
Companion clinical component to REHE 351. Clinical treatment in conjunction with residents and faculty.

COMP 328. Oral Diagnosis and Treatment Planning. 1 Unit.
Treatment planning based on the correlation of fundamentals taught in diagnosis, preventive dentistry and restorative dentistry. Clinical experience in the application of didactic training consists of four components; assignments in the admitting and radiology service where students carry out examinations of the newly admitted patients and evaluate their problems and needs; radiology seminars where the technique and interpretation of the radiographs taken by the students are discussed; assignments to the emergency service; and clinical conferences with a staff member.

COMP 348. Endodontics. 1 Unit.
Companion clinical component to DSRE 391. Clinical application of endodontic techniques.

COMP 358. Clinical Oral Surgery I. 1 Unit.
This clinical course introduces the student to patient management in clinical oral surgery, which includes infection control, patient evaluation, diagnosis, treatment planning, informed consent, local anesthetic procedures, and routine oral surgery procedures employed in a general dental practice.

COMP 378. Pediatric Dentistry Clinic. 1.5 Unit.
Companion clinical component of REMA 341.

COMP 384. General Dentistry Clinical Qualifying. 1 Unit.
This course consists of the successful completion of the recall clinical qualifying exam and two diagnosis and treatment planning clinical qualifying exams. It is also necessary for the student to successfully fulfill the recall needs of their assigned clinic patients in order to pass this course.
COMP 386. Quality Assurance. 1 Unit.
This course requires student dentists to evaluate their dental records against widely accepted written standards for dental record keeping. This is known as a comprehensive record audit. Records are broken down to their component parts, including but not limited to medical history, progress notes, treatment plans, and chartings. Emphasis is placed on making sure the required components are present, and adequate information is filled in for each component. Because records are partially electronic and partially written, it is essential that all entries that appear in both records are identical.

COMP 387. General Practice Dentistry A. 1.5 Unit.
Comprehensive dental care. Each student is assigned for clinical training to a preceptor group led by a practicing general dentist. The preceptor guides the students in diagnosis, treatment planning, and actual patient treatment with consultation in various specialties as required. Experience in the provision of emergency dental care. The preceptor directs the total dental health care of the patients of each of his students. Biweekly seminars are provided for each preceptor group. Special topics, student cases, techniques, and journal articles are discussed. Recommended preparation: Concurrent enrollment in DENC 387.

COMP 389. General Practice Dentistry B. 1.5 Unit.
Comprehensive dental care. Each student is assigned for clinical training to a preceptor group led by a practicing general dentist. The preceptor guides the students in diagnosis, treatment planning, and actual patient treatment with consultation in various specialties as required. Experience in the provision of emergency dental care. The preceptor directs the total dental health care of the patients of each of his students. Biweekly seminars are provided for each preceptor group. Special topics, student cases, techniques, and journal articles are discussed. Recommended preparation: Concurrent enrollment in DENC 389.

COMP 390. General Practice Dentistry A. 1.5 Unit.
Clinical application of the principles of general practice dentistry. Recommended preparation: Concurrent enrollment in DENC 390.

COMP 394. General Practice Dentistry B. 1.5 Unit.
Clinical applications of the principles of general practice dentistry. Recommended preparation: Concurrent enrollment in DENC 390.

COMP 417. Community Oral Health Capstone Experience. 1.5 Unit.
The goals of this particular course are to provide experience delivering dental care to a population of patients in a community health center while working with and communicating with a dental health care team and to gain experience in cultural sensitivity.

COMP 422. Periodontics. .5 Unit.
Clinical application of surgical and nonsurgical techniques used in the treatment of moderate periodontal disease. Students exposed to more advanced cases through clinical demonstrations by instructors. Students encouraged to gain additional experience and become more confident in the management of periodontal patients.

COMP 428. Oral Diagnosis and Radiology. .5 Unit.
Clinical experience in the admitting and radiology service.

COMP 448. Endodontics. 1 Unit.
Clinical application of the principles of endodontics therapy. Diagnosis and treatment planning. Management of endodontic emergencies and prognosis of endodontic treatment.

COMP 458. Clinical Oral Surgery II. 1 Unit.
Clinical application of the principles of oral surgery.

COMP 464. Operative Dentistry. 2.5 Units.
Clinical application of the principles of operative dentistry.

COMP 468. Removable Prosthodontics. 1.5 Unit.
Clinical application of the principles of prosthodontic dentistry.

COMP 474. Fixed Prosthodontics. 2.5 Units.
Treatment of patients requiring simple and advanced fixed prostheses as an integrated part of total patient care.

COMP 478. Pediatric Dentistry. 1.5 Unit.
Emphasizes comprehensive oral health care of the well child to provide experience in examining, diagnosing, treatment planning, and completing treatment of a selected number of children. Preventive aspects of pediatric dentistry emphasized. Additional voluntary experiences in clinical practice of pediatric dentistry available.

COMP 480. Clinical Geriatric Dentistry. .5 Unit.
The course exposes students to providing comprehensive care to a broad range of older adults in a variety of settings. Senior students will attend interdisciplinary team meetings to present dental findings, recommendations and to gain exposure to the impact of physiological aging, systemic conditions, functional disabilities, and pharmacological interactions on delivering comprehensive care to this vulnerable population.

COMP 482. Clinical Orthodontics. 1 Unit.
Clinical application of the principles of orthodontics.

COMP 487. General Practice Dentistry A. 2.5 Units.
Comprehensive dental care. Each student is assigned for clinical training to a preceptor group led by a practicing general dentist. The preceptor guides the students in diagnosis, treatment planning, and actual patient treatment with consultation in various specialties as required. Experiences in the provision of emergency dental care. The preceptor directs the total dental health care of the patients of each of his students. Biweekly seminars are provided for each preceptor group. Special topics, student cases, techniques, and journal articles are discussed. Recommended preparation: Concurrent enrollment in COMP 489.

COMP 489. General Practice Dentistry B. 2.5 Units.
Comprehensive dental care. Each student is assigned for clinical training to a preceptor group led by a practicing general dentist. The preceptor guides the students in diagnosis, treatment planning, and actual patient treatment with consultation in various specialties as required. Experiences in the provision of emergency dental care. The preceptor directs the total dental health care of the patients of each of his students. Biweekly seminars are provided for each preceptor group. Special topics, student cases, techniques, and journal articles are discussed. Recommended preparation: Concurrent enrollment in COMP 487.

COMP 490. General Practice Dentistry A. 2.5 Units.
Clinical application of the principles of general practice dentistry. Recommended preparation: Concurrent enrollment in COMP 494.

COMP 492. General Dentistry Clinical Competency. .5 Unit.
This course consists of the successful completion of the recall, emergency, diagnosis and treatment planning, and patient outcomes clinical competencies. It is also necessary for the student to successfully fulfill the recall needs of their assigned clinic patients in order to pass this course. Recommended preparation: Completion of Basic Core Program.

COMP 494. General Practice Dentistry B. 2.5 Units.
Clinical application of the principles of general practice dentistry. Recommended preparation: Concurrent enrollment in COMP 490.
COMP 495. Directed Clinical Studies. .5 - 8 Units.
This course is intended to provide students with the opportunity to advance their dental clinical patient skills in the comprehensive care clinics of the School while also providing advanced opportunity for students who are so inclined to focus in individual areas of clinical skills development.

COMP 498. Quality Assurance. 1 Unit.
This course reinforces quality assurance skills and knowledge provided in the prerequisite course including, but not limited to: providing students with the working knowledge of dental record keeping, as it relates to diagnosis and treatment of pathology; recognition and management of medical illness and disabilities; treatment planning; documentation of pre-existing conditions, current and past treatment; established laboratory protocols; evaluation of reasons for remakes and re-dos; post-treatment evaluation of care. Recommended preparation: COMP 394.

DENF Courses

DENF 422. Comprehensive Periodontics. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the periodontic procedures associated with general dentistry.

DENF 428. Comprehensive Oral Medicine. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have the approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the radiologic and oral diagnostic procedures associated with general dentistry.

DENF 448. Comprehensive Endodontics. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have the approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the endodontic procedures associated with general dentistry.

DENF 455. Comprehensive Oral Surgery. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have the approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the oral surgery procedures associated with general dentistry.

DENF 464. Comprehensive Operative Dentistry. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have the approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the operative procedures associated with general dentistry.

DENF 468. Comprehensive Removable Prosthodontics. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have the approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the removable prosthodontics procedures associated with general dentistry.

DENF 474. Comprehensive Fixed Prosthodontics. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have the approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the fixed prosthodontic procedures associated with general dentistry.

DENF 478. Comprehensive Pedodontics and Orthodontics. 3 Units.
This course is available only to dental school faculty who have earned dental degrees from foreign institutions and who have the approval of their Chairperson and the Dean to register. Successful completion of the course is accomplished by fulfilling the unit requirements, competency exams and any other written or practical requirements set forward by the Dental Education Committee and approved by the general faculty of the School of Dental Medicine in order to assure competency in the pediatric and orthodontic procedures associated with general dentistry.

DENT Courses

DENT 501. Biological Aspects of the Stomatological System. 0 - 2 Units.
This course is a review of biochemistry, molecular and cellular biology, histology, and oral anatomy and an expansion of oral biological topics that underlie the disciplines of endodontics, orthodontics, periodontics, and pediatric dentistry.

DENT 502. Correlative Medical Science. 0 - 2 Units.
Case-based discussion of selected systemic disease commonly encountered by the dentist.

DENT 503. Facial Growth and Development. 0 - 1 Units.
Emphasis on the qualitative, quantitative, and integrative changes during postnatal craniofacial growth and development.

DENT 504. Advanced Facial Growth. 1 Unit.
Student participation in seminar evaluation series dealing with problems and controversies apparent in the literature in regard to theories of growth, development, and aging. Emphasis on the craniofacial literature, but not exclusively.
DENT 505. Dentofacial Anomalies. 0 - 1 Units.
This course is designed to provide the student with the practical experience regarding the multidisciplinary aspects of diagnosis and treatment of patients with craniofacial anomalies. Observation of team sessions and active participation in patient examinations, diagnosis, and treatment planning.

DENT 507. Dental Ethics for the Graduate. 0 - 1 Units.
This 8 week course is given in group discussion format. Topics of ethical dilemmas, informed consent, professional (both national and local) codes of ethics, IRB introduction, patient autonomy, contractual obligations and purrery are discussed using case scenarios and student presentations.

DENT 508. Master's Thesis Protocol. 2 Units.
The requirements for the degree of Master of Science in Dentistry include the successful completion of a suitable research experience, demonstration of scholarly attainment, and the ability to conduct directed research.

DENT 509. Temporomandibular Disorders, Orofacial Pain and Sleep Disorders. 0 - 3 Units.
This course will enable first year dental residents to learn the principles of pain mechanisms, types of OFP and Sleep Disorders, differential diagnosis and management of these conditions in adults and children. By the end of this course the residents should be able to identify the most common types of OFP and sleep disorders, be able to make the differential diagnosis, and manage simple OFP case and / or refer the most complex OFP cases. Recommended preparation: DMD, DDS or equivalent degree.

DENT 510. Epidemiology and Biostatistics. 0 - 3 Units.
A detailed presentation of epidemiological and biostatistical techniques designed to acquaint the student with a broad spectrum of scientific approaches and to prepare for a research project. Topics include design of observational and experimental studies, common biostatistical techniques encountered in the dental literature such as t-test, ANOVA, chi-square, correlation and regression, and assessing the validity of diagnostic tests. Instruction includes lectures, critique of selected literature and computer analysis of data.

DENT 512. Advanced Oral Pathology. 0 - 3 Units.
Lectures and seminars on the clinical and histopathologic characteristics of many of the common oral diseases. Special emphasis on developing a logical approach to clinical and histopathologic diagnosis. Participation is expected for in-class discussion of the clinical and histopathologic material presented.

DENT 513. Anatomy of the Head and Neck. 0 - 3 Units.
This course deals with the structural, functional, and clinical relationships of the many organs and organ systems which comprise the head, neck, and pharyngeal regions of the human body.

DENT 514. Research Methods: Preparation. 0 - 1 Units.
The goal of this course is to facilitate a formal statement of the student’s research idea as preparation for working with a thesis committee or undertaking independent research.

DENT 516. Microbiology, Immunology, and Immune Systems. 0 - 1 Units.
This course reviews bacterial structure and classification, provides insight into oral bacterial pathogenesis. Principles of antibiotic use and mechanisms of resistance are reviewed. Microbial diagnostic methodologies are discussed. Integration of periodontics, endodontics, and pediatric dentistry is stressed as it relates to the inflammatory process in the human host.

DENT 518. Behavioral Considerations in Oral Health Care. 0 - 1 Units.
This course focuses on the behavioral knowledge and skills the oral health practitioner must possess in order to deliver effective, patient-centered care. Specifically, the course is designed to enhance graduate students' existing knowledge and skills in relation to dentist-patient communication, management of diverse patient populations, and patient education and facilitation of health behavior change.

DENT 520. Skeletal Anchorage. .5 Unit.
This course provides 1st year orthodontic residents with the theoretical knowledge and practical skills necessary to successfully treat orthodontic patients in need of absolute anchorage with orthodontic mini-implants. In addition, the most current articles in the orthodontic literature pertaining to this topic are read and discussed. The theory will be supplemented by practical exercises as necessary.

DENT 521. Manot Cave Dig, Israel. 0 - 1 Units.
This project is an ongoing collaboration between the CWRU School of Dental Medicine and Tel Aviv University. The newly discovered excavations have produced thousands of butchered deer bones, hundreds of stone tools, an one partial human skull. Traditionally CWRU faculty and students will be going in July to continue their work. Interested students are given the opportunity to learn basic archeological techniques while working in a newly discovered cave in Northern Israel. The Manot cave was discovered in 2008 and after 6 field seasons has yielded thousands of artifacts shedding light on what life was like for our early ancestors. Each participant will rotate through several stations including wet and dry sieving, excavation, and how to pick through the processed remains. They will learn how to identify stone and bone tools, faunal and floral remains. In addition to the hands-on experience they also get to attend field lectures by some of the world’s most famous researchers in human prehistory. Lodging is in comfortable cabins within easy walking distance from the cave site. This two-week field and lab experience is not only educational but also presents the opportunity to travel around the beautiful country of Israel.

DENT 522. Orthodontic Biomechanics. 1 Unit.
This course provides first year orthodontic residents with the theoretical biomechanical knowledge necessary to successfully treat a wide range of orthodontic malocclusions using the preadjusted straight wire appliance, the segmented arch technique, treatment auxiliaries, and orthodontic mini-implants. In addition, the most current articles in the orthodontic literature pertaining to this topic are read and discussed. The theory will be supplemented by practical exercises as necessary.

DENT 550. Clinical Pharmacology. 0 - 1 Units.
This course is designed to enable residents to obtain an understanding of the pharmacology of the most commonly prescribed medications; pharmacotherapeutic concepts in relationship to disease pathophysiology; rational drug therapy in the treatment of disease; drug-drug interactions and drug-disease interactions; adverse drug events. Residents will be expected to apply information on disease pathophysiology and pharmacotherapy to clinical cases. The ultimate goal is to provide relevant information to assist clinicians in practice.

DENT 555. Management of Medical Emergencies. 0 - 1 Units.
This course covers the diagnosis and management of common medical emergencies, with special emphasis on patient evaluation and history taking to prevent such emergencies in the dental office. Venipuncture technique and the use of emergency equipment are demonstrated. Also included is a basic course in cardiopulmonary resuscitation, with practical demonstrations and examinations that lead to certification in basic CPR.
DENT 561. Orthodontics for Pediatric Dentists I. 0 - 3 Units.
The course is designed to familiarize the pediatric dentistry residents with (1) the clinical evaluation of patients to determine appropriateness of orthodontic intervention, (2) record taking, (3) diagnosis, (4) treatment planning of cases in the mixed and permanent dentition, (5) treatment administration and (6) retention strategies. The primary focus will be on interceptive orthodontics including growth modification and corrective orthodontics in the permanent dentition. First in a series of four courses.

DENT 562. Orthodontics for Pediatric Dentists II. 1 Unit.
Second in a series of four courses. See DENT 561 Orthodontics for Pediatric Dentists.

DENT 564. Advanced Principles of Occlusion. 1 Unit.
This course is designed to provide in-depth knowledge of the structure and function of all anatomic components involved in occlusion, biomechanics of articulation and mastication; recording of mastication patterns; diagnosis of occlusal dysfunction; relationship to neuromuscular and temporomandibular joint anatomy and pathology; evidence based therapy used in the management of occlusal and temporomandibular disorders and its significance to inflammatory periodontal disease.

DENT 565. Practice Management I (Ortho). 0 - 1 Units.
Seminar and demonstration course designed to prepare the student for all phases of the “business” of orthodontics as well as the responsibility of being a “professional” Management of the department clinic, private practice management, office visitations, and the business community, and ethics through the use of guest speakers on jurisprudence, personal and professional insurance, accounting, estate planning, risk management, informed consent, banking, office design, organized dentistry and investments. First in a series of four courses.

DENT 567. Practice Management III (Ortho). 1 Unit.
Third in a series of four courses. (See DENT 565.)

DENT 568. Practice Management IV (Ortho). 1 Unit.
Fourth in a series of four courses. (See DENT 565.)

DENT 569. Orthodontic Literature Review I. 1 Unit.
The course will focus on contemporary and classic literature selected to cover a wide range of orthodontic topics. The selected literature includes the reading list suggested by the American Board of Orthodontics in preparation for the Part II of the ABO examination. Students will be required to discuss the articles and answer questions pertaining to the reviewed material.

DENT 570. Orthodontic Literature Review II. 1 Unit.
The course will focus on contemporary and classic literature selected to cover a wide range of orthodontic topics. The selected literature includes the reading list suggested by the American Board of Orthodontics in preparation for the Part II of the ABO examination. Students will be required to discuss the articles and answer questions pertaining to the reviewed material.

DENT 572. Pre-Clinical Principles in Orthodontics. 0 - 1 Units.
This course is comprised of a series of seminars presented by orthodontic faculty covering topics that will prepare the first orthodontic resident for the initial phases of clinical training.

DENT 573. Advanced Specialty Principles: Clinical I. 2 Units.
Full fixed orthodontic appliance treatment of patients in an educational setting. First in a series of four courses.

DENT 574. Advanced Specialty Principles: Clinical II. 2 Units.
Second in a series of four courses. (See DENT 573.)

DENT 575. Advanced Specialty Principles: Clinical III. 2 Units.
Third in a series of four courses. (See DENT 573.)

DENT 576. Advanced Specialty Principles: Clinical IV. 1 Unit.
Fourth in a series of four courses. (See DENT 573.)

DENT 580. Orthodontics-Oral Surgery Conference. 0 - 1 Units.
A seminar series involving a multidisciplinary approach to the treatment of patients with severe craniofacial deformities. Begins in the fall of each year (continuing for four semesters) with a series of lectures, followed by assignment of patients supervised jointly by the departments of orthodontics and oral surgery. Meetings held bimonthly to review patient progress, plan treatment, and present cases for discussion. Each student involved in all phases of treatment: presurgical orthodontics, the surgical procedure, finishing orthodontics, and retention.

DENT 583. Orthodontic Diagnostic Seminar I. 1 Unit.
Series of lectures and seminars covering the science of orthodontic diagnosis. Course consists of lectures on techniques of diagnosis, treatment planning, and critique of cases from the department or from faculty private practices. Content also includes long-term follow-up of post retention cases. First in a series of three courses.

DENT 584. Orthodontic Diagnostic Seminar II. 1 Unit.
Second in a series of three courses. (See DENT 583.)

DENT 585. Orthodontic Diagnostic Seminar III. 1 Unit.
Third in a series of three courses. (See DENT 583.)

DENT 586. Limited Tooth Movement for the Dental Specialist. 0 - 1 Units.
A review of the rationale for orthodontic treatment in periodontally diseased patients and in pre-restorative dentitions. Lectures, audio-visual programs, and technique sessions. Diagnosis, treatment planning, and various methods of tooth movement.

DENT 587. Periodontal Prosthesis. 1 Unit.
This course examines and defines the periodontal prosthetic interrelationships beginning with treatment planning and continuing with discussing the utilization of the combined treatment modalities. It focuses on provisionalization, furation treatment, occlusion, aesthetics, removable appliances, and special advanced treatment problems.

DENT 588. Hospital Rotation. 2 Units.
Students are assigned full time to anesthesia service and perform such duties as directed by anesthesiology staff: preoperative evaluation of patients, indications and contraindications for specific methods of anesthesia, relationship of medical problems to anesthesia risks, assisting in preparation of patients for anesthesia, intubation and anesthesia management, assisting in the management of complications, and post-anesthetic recovery management including monitoring of vital signs, blood gases, EKG, etc., and participation in post-anesthesia rounds and conferences.

DENT 589. Orthodontic Diagnostic Seminar IV. 1 Unit.
The fourth course in a series which consists of weekly lectures and seminars covering the science of orthodontic diagnosis. Consists of lectures on the techniques of diagnosis, various diagnostic aids, and case planning. Also consists of seminars where the students perform diagnosis, plan treatment and critique cases from the department. This course is used for long-term follow-up clinic.

DENT 651. Thesis M.S.D.. 1 - 9 Units.
Subsections for each program area of study: endodontics, orthodontics, periodontics, or pediatric dentistry.
DENT 661. Conscious IV Sedation I. 2 Units.
Didactic portion covers physical evaluation, physiology, pharmacology, emergencies, and techniques. Cardiac monitoring, basic life support, and advanced cardiac life support.

DENT 662. Conscious IV Sedation II. 1 Unit.
(See DENT 661.) Supervised clinical experience in conscious IV sedation.

DENT 663. Implant Dentistry I Periodontics. 1 Unit.
Designed to enhance the understanding of current concepts and their role in the multidisciplinary treatment of the patient.

DENT 664. Implant Dentistry II Periodontics. 1 Unit.
(See DENT 663.) Clinical demonstration, participation, and case presentation in implant dentistry.

DENT 682. Cephalometrics. 0 - 1 Units.
A lecture and laboratory course in cephalometric roentgenography leading to a thorough understanding of craniofacial radiographic techniques. Use of x-rays and radiation hygiene, and technical and interpretive proficiency.

DENT 683. Imaging and IT. 1 Unit.
This course is designed to give some basic computer knowledge and prepare the resident for the use of computers in the orthodontic office.

DENT 684. Radiology and Cephalometrics. 1 Unit.
Fundamentally related to cephalometric radiography, skeletal morphology, and cephalogram interpretations of historic analyses via the Kroghman-Sassouni Syllabus. Also, clinical evaluations of hard and soft tissue relationships of the airway and skeletal maturation are presented. The use of Bolton Standards in craniofacial analysis is stressed.

DENT 692. Restorative Fellowship. 6 Units.
Provides for 12 months of clinical and didactic training in all phases of general dentistry beyond the scope of predoctoral dental education. Areas of emphasis include advanced restorative techniques, proper selection of restorative materials, restoration of implants, fixed and removable prosthodontics, and esthetic dentistry. At the discretion of the course director, students may register for an additional 12 months, during which time the student will build on knowledge attained during the first year, continue with advanced didactic instruction, expand their clinical experience through continued patient care, participate in clinical research, and have teaching opportunities.

DENT 693. Fellowship of Advanced Clinical Education - Advanced Dental Studies. 1 - 9 Units.
Fellowship of Advanced Clinical Education (or F.A.C.E.) - Advanced Dental Studies is a special course per agreement in collaboration with Qassim University in Saudi Arabia.

DENT 694. Fellowship in Dentistry. 6 Units.
The Fellowship in Dentistry provides for advanced clinical, didactic and research training beyond the scope of the pre-doctoral dental education.

DENT 695. Oral Surgery Residency. 1 - 10 Units.
Allows registration for non-degree-seeking students in graduate level courses at the direction of the department.

DENT 696. Advanced Dental Training. 0 - 6 Units.
This course is a one year advanced training in dental medicine at Case Western Reserve University School of Dental Medicine. Responsibilities may include clinical and didactic responsibilities. The course is designed to give students clinical experience in a defined focus area.

DENT 697. Advanced Dental Training II. 1 Unit.
Continuation of Advanced Dental Training I. Prereq: D.D.S. or equivalent.

DENT 698. Multidisciplinary Seminar. 0 - .5 Units.
This seminar meets monthly to discuss multidisciplinary cases to develop treatment recommendations for the patients presented. Each graduate department selects a clinical case that requires the services of at least three dental specialties. Ideally, patients should be in the beginning stage of treatment planning so the input from the various specialties can be used to develop a comprehensive plan to establish a healthy oral environment. It is expected that several alternative treatments will be discussed and the relative merits of each approach evaluated. To maximize the benefit of this seminar to the student learning process, an attending faculty member should be present from each of the dental specialty programs. In addition, all seminars have a Prosthodontist to provide input on the restorative treatment options.

DENT 699. AEGD Residency Training. 1 - 8 Units.
This is a multidisciplinary course that encompasses didactic and clinical training in general dentistry.

DNDO Courses

DNDO 529. Endodontontology. 3 Units.
Scientific rationale for endodontic practice. Endodontic anatomy, physiology, pathology, and microbiology. All treatments and techniques studied and substantiated by current and classical research.

DNDO 539. Endodontic Literature Review. 3 Units.
Provides scientific basis for present and future treatment. Instructs students in critically evaluating literature. Provides format for lifelong self-education. Specific journal assignments summarized, evaluated, and presented for group discussion weekly.

DNDO 551. Clinical Endodontic Specialty. 3 Units.
Students present case histories as they encounter them in clinic. Cases discussed in detail and critically evaluated by colleagues and graduate endodontic faculty. Past endodontic literature discussed in detail as each student presents a topic assigned by faculty. Problems in clinic discussed. Several guest endodontists present various techniques and perform them.

DNDO 651. Sedation in Endodontic Practice. 1 - 3 Units.
5 modules designed to provide in-depth knowledge of minimal and moderate sedation to graduate endodontic students with the goal of becoming proficient in providing safe and effective minimal or moderate sedation to patients undergoing endodontic therapies. Recommended preparation: Current American Heart Association certification in BLS or Red Cross certification in Professional rescuer CPR.

DORL Courses

DORL 529. Oral Diagnosis / Med Seminar. 1 Unit.
Principles of diagnosis of oral mucosal disorders, clinical pathology and systemic pathology will be discussed in an interactive, case based format.

DORL 531. Clinical Oral Diagnosis and Oral Medicine. 1 Unit.
Clinical rotation in oral medicine and orofacial pain service.

DORL 532. Medical Specialty Services. 1 - 3 Units.
This course provides exposure to the graduate student to medical primary and specialty services and applications to the practice of oral medicine.

DORL 541. Clinical Oral and Maxillofacial Radiology. 1 Unit.
Learn the principles of CBCT, MRI, and other advanced imaging Assist in oral and maxillofacial reading service Recognize radiologic appearance of abnormal findings in the maxillofacial complex.
DORL 542. Advanced Oral Radiology. 1 Unit.
Seminar format review of advanced imaging techniques and interpretation on a one to one basis with faculty.

DORL 554. Current Concepts in Medicine. 1 Unit.
Students will review contemporary internal medicine topics of relevance to the oral medicine clinician.

DPED Courses

DPED 533. Pediatric Dentistry Literature Review. 0 - 2 Units.
Review of the literature in preparation for the specialty board examination in pediatric dentistry. Includes articles on various topics including growth and development, special needs patients, oral pathology and oral medicine, and clinical and hospital practice.

DPED 535. Fundamentals in Pediatric Dentistry. 0 - 3 Units.
Students present selected chapters from major pediatric dentistry review books for critique and discussion. Major strengths and weaknesses are emphasized. The course director then presents the most current information on the subject.

DPED 537. Advanced Clinical Pediatric Dentistry. 0 - 3 Units.
Students develop skills in diagnosis, radiographic technique, treatment planning, preventive and restorative dentistry, space management, trauma management, and nonpharmacologic behavior management. There is an opportunity to attend hospital grand rounds and physician conferences.

DPED 639. Advanced Seminar in Pediatric Dentistry. 0 - 3 Units.
Students present patient cases for in-depth discussion of specific clinical problems.

DPED 690. Pediatric Dental Residency. 0 - 10 Units.
Allows registration for non-degree-seeking students in graduate level courses at the direction of the department.

DPER Courses

DPER 519. Introduction to the Graduate Periodontology Program. 0 - 1 Units.
Introduction to the Graduate Periodontology Program. Introduce first year residents to the Graduate Periodontal Clinic and Program. the course consists of a series of seminars to discuss a variety of topics regarding patient care in the Graduate Periodontics clinic.

DPER 557. Periodontal Conference. 1 Unit.
Presentation of treated patients with advanced periodontal disease. Discussion of the clinical findings, etiology, diagnosis, and treatment plan. Critical review of the different surgical procedures used in therapy and evaluation of postoperative results. First in a series of four courses.

DPER 577. Clinical Periodontics. 0 - 6 Units.
Clinical practice of periodontics supplemented by case evaluation and treatment planning. A comprehensive study of normal and diseased periodontal tissues including etiology and diagnosis. Current modes of therapy-rationale technique, and prognosis. First in a series of four courses.

DPER 595. Advanced Periodontal Seminar. 1 - 3 Units.
Series of seminars covering clinical, histological, and physiological aspects of the periodontium in health and disease, etiology, diagnosis, prognosis, prevention, and treatment of periodontal disease, as well as the relationship of periodontics to other phases of dentistry.

DPER 685. Literature Review in Periodontics. 1 Unit.
Comprehensive discussion of selected articles related to clinical periodontology and basic sciences of significance to periodontal research and therapy.

DPHC Courses

DPHC 501. Principals of Oral Epidemiology and Research Methods. 2 Units.
This course will address the distribution and determinants of oral and dental diseases at the local, state, national and international levels. Students will be instructed on the application of various dental indexes. Survey research methodology including questionnaire, development, and different forms of validity are also some of the topics taught. The course will enable students to identify and formulate a research question that will be developed into a research proposal, to fulfill their residency requirement.

DPHC 505. Communication Methods in Dental Public Health. 2 Units.
This course will prepare students to be adept in searching scientific literature and gain/augment their skills in communicating as public health professionals. This skill set includes preparing literature reviews, manuscripts, developing research proposal and for this purpose students will gain proficiency in relevant software such as Reference Manager/EndNote/Adobe Connect. Students will be familiar with the different elements of a research proposal and gain skills in writing these components.

DPHC 507. Data Analysis and Reporting. 2 Units.
Data Analysis and report writing will prepare residents to be proficient in analyzing public health/epidemiological by instructing them on the appropriate use of univariate, bivariate, and multivariate statistical test. Students will use either primary or secondary data sets for such applications. Based on their previously approved research proposal and the results of the data analysis residents will write a scientific report to fulfill one of the requirements of the residency program.

DPHC 508. Dental Public Health Administration. 2 Units.
This course describes the history of dental public health, its principles, and the discipline as a recognized dental specialty. Understanding the discipline/profession and administration at local, state, national, and international levels will enable the graduates to be effective public health administrators.

DPHC 530. Graduate Preventive Dentistry. 2 Units.
This course will address primary, secondary, and tertiary prevention methods to prevent oral and dental diseases with the particular focus on groups of people rather than individual patients. Instruction on cost-effectiveness of different preventive modalities will enable students to choose the applicable program for specific populations.

DPHC 532. Oral Health Care Systems. 2 Units.
The course on oral health care systems will provide an insight into the dental care systems in the U.S. including different forms of financing, private, public, etc. Knowledge of the system will enable future dental public health professionals to recognize the oral health workforce models and their appropriateness to public health settings to provide dental care to various groups.

DPHC 551. Research in Dental Public Health I. 1.5 Unit.
One of the core aspects of dental public health training at CWRU is to augment residents’ research skills; each resident will be required to develop, implement, and complete at least one research project during the training. The project may involve primary data collection or the use of secondary data for analysis. The program director, members of the residency committee, and experts working in the area of each resident’s interest will assist with the selection of an appropriate research topic and getting IRB approval. Following the data analysis, each resident will submit and defend a written report of the project. Acquisition of research skills will be facilitated by didactic courses and periodical meetings with the residency director and members of the residency committee.
**DPHC 552. Research in Dental Public Health II. 1.5 Unit.**
One of the core aspects of dental public health training at CWRU is to augment residents’ research skills; each resident will be required to develop, implement, and complete at least one research project during the training. The project may involve primary data collection or the use of secondary data for analysis. The program director, members of the residency committee, and experts working in the area of each resident’s interest will assist with the selection of an appropriate research topic and getting IRB approval. Following the data analysis, each resident will submit and defend a written report of the project. Acquisition of research skills will be facilitated by didactic courses and periodical meetings with the residency director and members of the residency committee.

**DPHC 555. Dental Public Health Practicum I. 1.5 Unit.**
Supervised field experience is an integral part of the advanced education program in dental public health at CWRU; the numerous field experiences are designed to augment residents’ requisite public health skills as well as community-oriented primary care. The sites for field experience include Medina County Health Department, Akron Health Resources Inc., Free Medical Clinic of Greater Cleveland, etc. These sites have been carefully chosen for DPH residents to improve public health skills, which would enable them to succeed as a dental public health professional.

**DPHC 556. Dental Public Health Practicum II. 1.5 Unit.**
Supervised field experience is an integral part of the advanced education program in dental public health at CWRU; the numerous field experiences are designed to augment residents’ requisite public health skills as well as community-oriented primary care. The sites for field experience include Medina County Health Department, Akron Health Resources Inc., Free Medical Clinic of Greater Cleveland, etc. These sites have been carefully chosen for DPH residents to improve public health skills, which would enable them to succeed as a dental public health professional.

**DPHC 599. Independent Study in Dental Public Health. 1 - 9 Units.**
The aim of this course is for dental public health residents to gain an in-depth understanding of selected topics in public health and/or augment their skills in epidemiological research methodology. Students will choose their topic(s) of interest in consultation with the course director and attain the requisite skill levels through assigned readings and written assignments. Students opting to augmenting their research skills will be required to complete a research project by developing and implementing the project followed by data analysis and writing a report.

**DRTH Courses**
**DRTH 510. Humans: An Evolutionary Biology. 0 - 2 Units.**
**DRTH 523. Clinical Specialty Seminar. 2 Units.**
This course is a companion to clinical training in orthodontics and involves faculty and student evaluation of past and present literature. Sessions are used to evaluate current timely literature, and lectures and seminars complement the clinical experiences with topics including patient management, treatment of various aged populations and malocclusions, orthopedic appliances, treatment of patients with special needs, and various aspects of fixed and removable mecanotherapy.

**DSPR Courses**
**DSPR 136. Cariology. 1 Unit.**
This course in cariology includes clinical features, etiology, risk assessment, and prevention of caries. The course will enable students to understand the etiology, patho-physiology, and clinical aspects of caries, which would complement the first Problem-Based-Learning module, Epidemiology for Public Health and Clinical Practice. In addition, this course will prepare the first-year students for their sealant rotation where they will be seeing clinical features of caries in children.

**DSPR 232. Periodontics. 1 Unit.**
A comprehensive course in periodontology including etiology, diagnosis, radiographic, interpretations and prognosis.

**DSPR 234. Oral and Maxillofacial Pathology. 2 Units.**
Diseases and abnormalities of the teeth and adjacent hard and soft tissues. Includes periodontal, pulpal, and periapical diseases as well as cysts, tumors, developmental anomalies, and oral aspects of systematic disease.

**DSPR 239. Neoplasia. 1 Unit.**
Topics covered in this educational module include tumor nomenclature, features of benign versus malignant tumors, cytologic characteristics of cancer cells, pathogenesis and prognosis.

**DSPR 244. Principles of Medicine. .5 Unit.**
The didactic curriculum provides a general background and discussion of the risk assessment of medical conditions in an ever-increasing aging population. Within the setting of out-patient care, as well as those that are hospitalized, patients often present for dental procedures with co-existing medical systemic illness that provide an added challenge to the dental provider. Management of these medical problems within the context of dentistry and medicine will be covered.

**DSPR 333. Management of Medical Emergencies. 1 Unit.**
Patient evaluation, diagnosis and treatment of life-threatening emergencies that may arise in the course of dental treatment. Includes instruction in basic life support and cardiopulmonary resuscitation.

**DSPR 341. Oral Diagnosis and Radiology. 2 Units.**
This course helps the beginning clinician develop and understand the diagnostic process. It is designed to present to the student a method by which the common oral problems facing the dental practitioner can be recognized, diagnosed, evaluated and managed.

**DSPR 342. Oral Cancer Diagnosis. 1 Unit.**

**DSPR 426. Oral Diagnosis Seminar. 1 Unit.**
Case-based review of oral diagnosis, radiology, and medicine.

**DSRE Courses**
**DSRE 335. Clinical Pharmacology. 2 Units.**
This course is designed to review common pharmacologic agents encountered in the general population. Emphasis is placed on the prescription, action, and interaction of dental pharmacologic agents as well as the implication of medical prescriptions on dental therapy. The course culminates in the evaluation of case studies and problem solving in drug therapy.

**DSRE 370. Principles of Oral and Maxillofacial Surgery II. 1 Unit.**
DSRE 374. Fixed Prosthodontics. 1 Unit.
The course describes further development of principles and clinical applications introduced in DSRE 259 and DSRE 260, Basic Procedures in Fixed prosthodontics, with emphasis on diagnosis, treatment planning, clinical and laboratory procedures in fixed prosthodontics. Discussion and comprehensive overview of fundamentals and advanced methods of restoring function and esthetics for partially edentulous patients with fixed prostheses.

DSRE 391. Endodontics. 1 Unit.
Recognition of endodontic pulpal health and the changes that occur in the transition from health to disease. The didactic component focuses on scientific basis for recognition of degenerative states of the dental pulp and the philosophy of endodontic therapy. The clinical component focuses on the treatment of diseased, pulpally-involved teeth of actual patients. It provides practical instruction on how to render endodontic therapy under the direct supervision of qualified endodontic personnel.

DSRE 392. Nitrous Oxide and Conscious Sedation. .5 Unit.
Physiopharmacology of nitrous oxide use. Indications, contraindications, and complications.

DSRE 393. Principles of Oral and Maxillofacial Surgery I. 1 Unit.

DSRE 395. Introduction to Oral and Maxillofacial Surgery. .5 Unit.
This didactic course is designed to prepare the student for oral surgery clinical rotations and is comprised of the following topics, review of local anesthesia, review of applied anatomy, infection control, patient assessment and case presentation, informed consent, oral surgical armamentarium, and principles of exodontia.

DSRE 397-1. Temporomandibular Disorders and Occlusion. 1 Unit.
The didactic portion of the course describes anatomy, biomechanics, and the maintenance of, the pathology associated with and the restoration of the masticatory or stomatognathic system. It includes Temporomandibular Disorder and other types of Orofacial Pains such as Primary Headache Disorders, Neuropathic Orofacial Pain, Psychogenic Pain, and Dental Sleep Medicine.

DSRE 397-2. Temporomandibular Disorders and Occlusion. 1 Unit.
The didactic portion of the course describes anatomy, biomechanics, and the maintenance of, the pathology associated with and the restoration of the masticatory or stomatognathic system. It includes Temporomandibular Disorder and other types of Orofacial Pains such as Primary Headache Disorders, Neuropathic Orofacial Pain, Psychogenic Pain, and Dental Sleep Medicine.

EFDA Courses

EFDA 111. Tooth Morphology for the EFDA. 1 Unit.
Instructional laboratory sessions provide experience with viewing models of teeth as well as reproducing teeth in wax. Mastery of terminology and basic facts of dental anatomy and tooth positions of permanent and primary teeth. Introduction of proper instrumentation begins.

EFDA 113. Dental Materials for the EFDA. 1 Unit.
Instructional laboratory sessions cover the physical and chemical properties and uses and manipulation of materials used in protection of the pulp and intracoronal temporization. Composition, properties and manipulation of dental amalgam, composite and pit and fissure sealant materials are also introduced. Isolation techniques and rubber dam placement lab.

EFDA 115. Restorative Dentistry for the EFDA I. 3 Units.
Skill development in the placement and carving of Class I, II, V and complex amalgam restorations on the typodont. Skill development in the placement and finishing and polishing of Class I, II, III, IV, and V composite restoration and amalgam restoration finishing and polishing on the typodont. Continued skill development in instrumentation, body positioning and ergonomics. Skill development in the use of low and high speed handpieces for rotary instrument use in finishing and polishing restorations. Skill development in self-evaluation using specific criteria. Pit and fissure sealant applications. **Student must show competency of skills acquired to be able to progress in Clinical Practicum for the EFDA**.

EFDA 116. Restorative Dentistry for the EFDA II. 2 Units.
Students begin preparation for the state board examination by demonstrating successful completion of amalgam and composite restorations with increasingly difficult grading evaluation, mastery of self evaluation skills, decreasing restoration placement time and by completing 3 mock board examinations. Students must pass a final clinical and didactic examination to pass the course. Emphasis on understanding Ohio EFDA Registration protocol.

EFDA 120. Clinical Practicum for the EFDA. 2 Units.
Students fulfill the Ohio State Dental Board requirement of having clinical experience on patients in CWRU approved dental clinics. Clinic sessions include a variety of restorative experiences on many patients. One 8 hour session is required for 4 weeks. Students will restore patients’ teeth under the supervision of a licensed dentist and a clinical supervisor in clinics affiliated with CWRU. Emphasis is placed on restoring metallic and non-metallic restorations.

EFDA 122. Clinical Board Review. .5 Unit.
Review of Restorative Expanded Functions for the Dental Auxiliary. This two day course is designed to prepare the Registered Dental Hygienist or Certified Dental Assistant for the EFDA certification examination administered by the Commission on Dental Testing in Ohio. Successful completion of an approved EFDA course is a prerequisite for attendance. This course meets the requirements as remediation for auxiliaries who have not passed the certifying examination after two attempts. The course will involve both laboratory reviews and practice, preparing the participant for the clinical examination.

HEWB Courses

HEWB 121. Foundations of Life Science. 4.5 Units.
This course includes an introduction to basic elements of cell structure and function. This includes the characteristics and role of different types of cells, the cell cycle, mechanisms for cell damage, repair and death, cell signaling, differentiation and gene expression. This course serves as a foundation for the modules in Health and Wellbeing and Disease Processes.

HEWB 123. Facial Growth. 1.5 Unit.
Introduction to the normal growth and development of the human face from embryology to adult.

HEWB 124. Masticatory Dynamics. 2 Units.
Descriptive anatomy of masticatory structures with emphasis on deciduous and permanent teeth and the temporomandibular-mandibular movements, and the fundamental concepts of the functional relationships between the dentition and the temporomandibular joint. Lectures on comparative anatomy and variations in tooth morphology.

HEWB 126. Masticatory Dynamics Lab. 1.5 Unit.
Companion pre-clinical component to HEWB 124. Laboratory exercises and assignments include drawings, waxups and tooth identification, and use of semi-adjustable articulator.
HEWB 128. Body as Host. 4.5 Units.
This educational module focuses on the role of bacteria, viruses, and fungi in immune function that preserves and maintains health and discusses host changes that occur during oral and systemic disease processes.

HEWB 130. Oral Histology. 1.5 Unit.
Development of teeth and supporting tissues. Histology and ultrastructure cytology of the oral region with emphasis on the calcified tissues.

HEWB 134. Head and Neck Structure and Function. 4.5 Units.
This course explores the developmental, cellular, physiologic, anatomic and biochemical components of the head and neck region. The focus is both healthy functioning and disease of the head and neck area.

HEWB 200. Directed Studies. 1 - 6 Units.
Directed study under faculty supervision and with special permission of the Associate Dean for Education.

HEWB 349. Dentofacial Morphology. 1 Unit.
This course provides the dental student with an introduction to the assessment of dynamic faces and the relatively static dentition. The course details the etiologies and characteristics of various malocclusions including developmental disharmonies observed during the growth and development of a child. Primary emphasis is laid on empowering the student in the diagnoses of malocclusions employing study casts, intra and extra-oral photographs and, cephalograms.

**HWDP Courses**

HWDP 131. Heart and Lungs in Health and Disease. 4.5 Units.
This course provides students with the understanding of the structural and functional relationships of the cardiovascular and respiratory systems. This integrated approach serves as a foundation for understanding the health and well-being of these systems. This education module also facilitates student recognition of cardiovascular and respiratory dysfunction that may be present in their patients and help students understand how such conditions may affect their patients’ general and oral health.

HWDP 232. Renal and Hematologic Systems in Health and Disease. 2 Units.
This educational module focuses on the understanding of the structural and functional relationships of the renal and hematologic systems. This integrated approach serves as a foundation for understanding the maintenance of health and well-being as well as disease processes within the body.

HWDP 241. Gastrointestinal System in Health and Disease. 2 Units.
This educational module focuses on the understanding of the structural and functional relationships of the many components of the gastrointestinal system in health and disease.

HWDP 243. Endocrine and Reproductive Systems in Health and Disease. 1.5 Unit.
This educational module focuses on the understanding of the structural and functional relationships of the many components of the endocrine and reproductive systems in health and disease.

HWDP 245. Musculoskeletal System in Health and Disease. 1.5 Unit.
This educational module focuses on the understanding of the structural and functional relationships of the many components of the musculoskeletal system in health and disease.

HWDP 246. Neuroscience in Health and Disease. 2 Units.
An integrated approach to the anatomy and physiology of the human nervous system. Analyzes neuronal phenomena at both cellular and systems levels.

**INQU Courses**

INQU 102. ACE: Knowing the Patient. 2 Units.
This ACE introduces the student to professional patient interaction and evaluation in a simulated environment. Students will develop interview techniques, learn patient appraisal skills, and techniques for communicating effectively in a health care environment. Students will experience patient interviews and assessment in a simulated environment with live patients.

INQU 200. Directed Research. .5 - 6 Units.
Directed research activities under faculty supervision and with special permission of the Associate Dean for Education.

**LDRS Courses**

LDRS 100. Introduction to Interprofessional Education and Collaboration. .5 Unit.
The last decade has seen a growing emphasis on fostering the ability of healthcare providers from different professions to more effectively communicate and collaborate in the care of patients in order to improve the patient’s care experience, to improve population health outcomes and to create a more cost-effective healthcare system. Interprofessional education (IPE), in which students from different professions learn about, with and from each other, can help to develop skills for interprofessional communication and collaboration. This course serves as a foundational interprofessional education experience for first year dental students.

LDRS 111. Epidemiology for Public Health and Clinical Practice. 2.5 Units.
This 3 week intensive sequence provides the first experience with the problem-based learning format and focuses on the content foundation in epidemiology and skills for evidence-based practice in dentistry. Problem-based cases will use oral health topics to present the skills for critical appraisal of health literature. Small-group settings will permit students to gain experience in applying these skills to relevant dental literature.

LDRS 116. Promoting Evidence-based Dentistry I. .5 Unit.
The course aims to enhance and apply the use of evidence-based practice skills and critical thinking in D1 and D2 in preparation for use in clinical training. Using diverse formats, students will enhance their skills to be efficient and effective in acquiring, appraising and applying scientific evidence in didactic, pre-clinical and early clinical coursework. The course topics and requirements will be integrated with concomitant course work to enhance relevance. Student assignments can be included in a portfolio to demonstrate progress and competency.

LDRS 310. Professional Development. 1 Unit.
Major issues and trends that affect oral health and the mission of dentistry in the United States. Behavioral knowledge and skills essential to the oral health practitioner’s ability to deliver effective patient-centered care.

LDRS 313. Dental Patient Management/Risk Management. 1 Unit.
Principles of patient management and risk management are reviewed. The primary focus is directed toward the skills associated with communication. A variety of examples of malpractice are reviewed and discussed. Other areas of risk are discussed such as infection and occupational hazards related to EPA and OSHA standards.
LDRS 316. Practice Management I. 1 Unit.
This course is designed to develop practical knowledge and skills in
dental practice management. It is organized around initial topics that
will lay the foundation for adequate planning for practice success
after graduation. The subsequent courses build upon this foundation
knowledge so that students will have a general perspective of where to
begin their strategies for success in the future. This course discusses
topics that include analysis of practice configurations, choosing
the appropriate consultants, basic tools for fiscal management and
evaluation, and identifying opportunities that match the student's life
goals.

LDRS 317. Dental Auxiliary Management. .5 Unit.
This course introduces students to each type of auxiliary personnel in the
dental office and describes their training, testing, duties delegated legally
and how their utilization in the office setting can be optimized. Basic
management considerations and theories of leadership are presented
and various leadership styles are recommended for situations presented.
This course provides an understanding of interacting with auxiliary
and the process of delegation. The course defines state dental board
rules and regulations that guide dentists in the utilization of auxiliary
personnel. Such items as overhead costs are explored in relation to each
auxiliary category.

LDRS 415. Practice Management II. 1 Unit.
Students deal with entrepreneurship applications and experiences
specific to dentistry and are introduced to the process of formulating a
business plan. Personal finance and investment strategies are covered in
this course, particularly as they pertain to developing a business plan for
the students' careers. Each student constructs a business plan specific
to the goals and situation of that student.

LDRS 416. Practice Management III. 1.5 Unit.
This course is designed to develop practical knowledge and skills
in dental practice management. As the student prepares for clinical
practice, topics surrounding negotiation of working contracts, insurance
contract evaluation, policies, compliance, and marketing are among
some of the most important issues to be familiar with. Skills acquired
in the preceding course are applied to the student's "practice" (panel of
patients) for evaluation of practice productivity and growth.

LDRS 420. Jurisprudence and Professional Ethical Responsibility. .5 Unit.
Ethical and legal issues, civil and criminal law, contracts, malpractice and
current ethical and legal dilemmas encountered in practice.

MAHE Courses

MAHE 141. Preventive Periodontics. 1 Unit.
A laboratory lecture and clinical course in basic procedures including
scaling, polishing, instruction in home care, and a system of
instrumentation for thorough prophylaxis in preparation for clinical
treatment. An understanding of the formation, composition, and relation
of dental plaque to the occurrence and prevention of periodontal
disease. Emphasis on periodontal health and recognition of early disease
condition.

MAHE 144. Preventive Periodontics Clinic. 1 Unit.
Companion clinical component to MAHE 143. Clinical application of
methods for the prevention and maintenance of periodontal health
in patients. The importance of patient education, motivation, and
cooperation in present methods of prevention and plaque control.

MAHE 145. ACE: Outreach Preventive Dentistry. 2 Units.
This didactic course provides generalized background of dental sealant
placement and other preventive procedures. In addition the student will
develop the knowledge of ethical dental practice and cultural awareness
while providing care for an under-served population. The lab and clinical
portion of the course will establish the student's ability to provide dental
sealants.

MAHE 147. ACE Clinical Outreach Preventive Dentistry. 2 Units.
The student will have the opportunity to practice their knowledge of
ethical dental practice and cultural awareness while providing care for an
under-served population by providing screening and dental sealants for
children in the Cleveland Metropolitan School District (CMSD).

MAHE 214. ACE: Family First. 1 Unit.
The overarching goal of the clinical experience (ACE) is to incorporate the
concepts of risk assessment and the importance of the family unit to oral
health. The Family First ACE will allow students to explore the interaction
between genetic and environmental factors in oral diseases and certain
systemic conditions (diabetes, hypertension, and asthma). At the end of the
"Family First" rotation the students would have achieved certain
didactic and clinical objectives and the experience is linked to the second
year didactic courses: Cariology, Periodontology, and Oral Pathology. This
experiential learning includes clinical experience, didactic lectures, and
small group discussions. Risk assessment for common oral diseases
such as caries and periodontal diseases as well as for oral cancer is part
of the clinical activities. Students will review the risk assessment and
systemic health to delineate genetic and environmental factors through
small group discussions.

MAHE 242. Periodontics. 1 Unit.
Companion clinical component for DSPR 232. Students observe and
assist at periodontal surgical procedures on moderately advanced
periodontal diseases. Treatment includes root planing, curettage,
occlusal adjustment, minor tooth movement and case maintenance.

MAHE 340. Nutrition for Dentistry. 1 Unit.
General nutrition concepts are presented in addition to aspects pertinent
to the practice of dentistry.

OMFS Courses

OMFS 694. Program Year 1. 1 - 3 Units.
Interns are expected to take calls at UH and, where applicable, the
Veteran's Administration (VA). After the initial two months at UH,
one of the interns will begin a three-month rotation at the VA as the
principal OMFS resident. Both rotations will give the intern experience
in diagnosis, information-gathering, dentoaveolar surgery, and major
surgery within the scope of OMFS. The last two months of the first year
are spent on the UH Anesthesia service. The resident will be paired with
an anesthesiology resident or attending, improving upon and learning
procedures involving management of the medically-compromised patient,
airway management, pharmacologic management, intravenous sedation
and general anesthesia. Formal conferences are held to advance the
residents in oral and maxillofacial pathology, contemporary issues in
OMFS, orthognathics, implantology and anesthetic principles, case
presentation, and OMFS knowledge updates. As well, interns are second
year medical students and take part in a full-year course in physical
diagnosis.
OMFS 695. Program Year 2. 1 - 3 Units.
Students must complete 40 weeks of basic core clerkships through the academic year. Family Medicine, Internal medicine, Aging, OB-GYN, Pediatrics, Neuroscience, Psychiatry, surgery, and emergency medicine. They must complete 8 additional weeks of clinical electives, this may include a OMFS rotation.

OMFS 696. Program Year 3. 1 - 3 Units.
Interns are expected to take calls at UH and, where applicable, the Veteran's Administration (VA). After the initial two months at UH, one of the interns will begin a three-month rotation at the VA as the principal OMFS resident. Both rotations will give the intern experience in diagnosis, information-gathering, dentoavolar surgery, and major surgery within the scope of OMFS. The last two months of the first year are spent on the UH Anesthesia service. The resident will be paired with an anesthesiology resident or attending, improving upon and learning procedures involving management of the medically-compromised patient, airway management, pharmacologic management, intravenous sedation and general anesthesia. Formal conferences are held to advance the residents in oral and maxillofacial pathology, contemporary issues in OMFS, orthognathics, implantology and anesthetic principles, case presentation, and OMFS knowledge updates. As well, interns are second year medical students and take part in a full-year course in physical diagnosis.

OMFS 697. Program Year 4. 1 - 3 Units.
Fourth-year residents are primarily off-service as general surgery interns. Residents rotate through plastic surgery, ENT surgery, general surgery, dermatological surgery, and trauma surgery at UH and MetroHealth hospital.

OMFS 698. Program Year 5. 1 - 3 Units.
During this senior year, the resident returns to the OMFS service as chief for six months. The chief resident is responsible for the resident service, working-up surgical cases and is typically the first assistant in major surgical cases. During this time, the chief works closely with the AEGD residents to plan and perform surgery on simple and advanced implant cases.

REHE Courses

REHE 151. Dental Anatomy. 3 Units.
Descriptive anatomy of masticatory structures with emphasis on deciduous and permanent teeth and the temporomandibular-mandibular movements, and the fundamental concepts of the functional relationships between the dentition and the temporomandibular joint. Lectures on comparative anatomy and variations in tooth morphology.

REHE 152. Basic Procedures in Fixed Prosthetics. 1 Unit.
To introduce and familiarize the dental student to basic principles related to fixed prosthodontics. The introduction will emphasize principles of engineering and preparation designs, full coverage retains for both metal and ceramic restorations.

REHE 153. Dental Anatomy Laboratory. 1 Unit.
Companion preclinical component to REHE 151. Laboratory exercises and assignments include drawings, waxups, tooth identification, and use of semi-adjustable articulator.

REHE 154. Basic Procedures in Fixed Prosthetics Lab. 1 Unit.
Laboratory component of REHE 152.

REHE 156. DentSim Laboratory. 1 Unit.
This course covers the criteria, techniques and practice of preparing ‘ideal/standard’ operative preparations. The restorative procedures will be performed on typodont teeth mounted in a computer assisted simulator (DentSim).

REHE 158. Dental Materials I. .5 Unit.
The primary goal is to introduce basic material science concepts needed to evaluate, compare and select materials for a specific application. Knowledge of properties, indications and limitations of different clinical and laboratory materials will be presented. The effect of manipulation variables on material properties will be emphasized.

REHE 162. Basic Procedures in Operative Dentistry I. .5 Unit.
This course, together with REHE 172 introduces students to the criteria, the techniques for, and practice of preparing ‘ideal/standard’ Class I and V operative preparations. In this course, the emphasis will be on the more traditional posterior amalgam Class I and Class V Preparations. Students will be introduced to basic cariology and radiology as it relates to operative dentistry. In addition, the composition and properties of amalgam will be reviewed in the Dental Materials Course. The restorative procedures will be performed primarily on typodont teeth mounted in a simulator. The emphasis will be on traditional preparation design and execution.

REHE 172. Basic Procedures in Operative Dentistry I Lab. .5 Unit.
Laboratory component of REHE 162.

REHE 229. Introduction to Radiography. 1.5 Unit.
Initial course consisting of lecture and laboratory covering basic principles of radiography. Included are: instructions on taking intraoral radiographs, radiation physics involved in x-ray generation and the parts and function of the x-ray unit, radiation biology of x-ray interaction with tissue, head and neck anatomy and pathology with regards to radiographic interpretation. Each student will have a clinic rotation.

REHE 252. Pain Control. 1 Unit.
Anatomy pertaining to local anesthesia. Drugs used in local anesthesia and technique of administration. Management of complications. Slides and clinical demonstrations.

REHE 253. Basic Procedures in Esthetics. 1 Unit.
This course provides formal lecture presentations and laboratory exercises to introduce the students to basic operative procedures for direct composite resin restorations.

REHE 254. Pharmacology. 4 Units.
This course introduces students to the principles of pharmacology and to the mechanisms of drug action in the context of common disease states.

REHE 256. Radiologic Interpretation. 1 Unit.
This is a continuation of REHE 229. Follow up course to Imaging Principles and Techniques with a primary focus on Radiographic Interpretation, consisting of lecture and laboratory covering basic principles of radiography interpretation and diagnosis. Each student will have a clinic rotation.

REHE 257. Prosthodontic Technology. 2 Units.
A lecture-demonstration-laboratory approach to complete denture prosthesis construction. Emphasis on certain fundamental biological considerations of the edentulous patient, such as the oral membranes, muscles, bones, and phonetics and how they relate to the technical aspects of denture constructions.

REHE 258. Principles of Treatment Planning I. 1 Unit.
This course provides lecture presentations to help prepare the student to develop skills in patient diagnosis and treatment planning. The lectures will guide the students through the thought processes necessary in the development of workable treatment plans. The emphasis will be on exposing the students to the approach used in our clinic of providing the patients with options of optimal, alternative and emergency diagnostic or recall treatment plans using decisional analysis.
REHE 259-1. Basic Procedures in Fixed Prosthodontics II. 1 Unit.
This course builds upon those core elements covered in REHE 152/154. Emphasis on principles of engineering for fixed partial dentures, preparation and design of fixed partial dentures, considerations for the restoration of endodontically involved teeth, and definitive and provisional fixed partial denture restorations. Introduces dental material topics related to fabrication of a fixed partial denture restoration, including: chemico-mechanical soft tissue retraction, die spacers, investments, casting and casting alloys, ceramics, soldering, provisional materials, prefabricated and custom post and core systems.

REHE 259-2. Basic Procedures in Fixed Prosthodontics II. 1 Unit.
This course builds upon those core elements covered in REHE 152/154. Emphasis on principles of engineering for fixed partial dentures, preparation and design of fixed partial dentures, considerations for the restoration of endodontically involved teeth, and definitive and provisional fixed partial denture restorations. Introduces dental material topics related to fabrication of a fixed partial denture restoration, including: chemico-mechanical soft tissue retraction, die spacers, investments, casting and casting alloys, ceramics, soldering, provisional materials, prefabricated and custom post and core systems.

REHE 260-1. Basic Procedure Fixed Prosthodontics II Lab. 1 Unit.
Laboratory component of REHE 259.

REHE 260-2. Basic Procedure Fixed Prosthodontics II Lab. 1 Unit.
Laboratory component of REHE 259-1.

REHE 262. Basic Procedures in Operative Dentistry II. 1 Unit.
This course, together with the first year Intro to BP Operative Dentistry and the BP Esthetic Dentistry Course covers the criteria, the techniques for, and practice of preparing ‘ideal/standard’ operative preparations and placement of operative restorations. In this portion of the course, the emphasis will be on posterior Class II amalgam preparations and restorations, as well as an introduction to cast gold inlay and onlays, and an introduction to CEREC (CEramic REConstruction) Onlays. Students will be introduced to basic cariology and radiology as it relates to operative dentistry. In addition, the composition and properties of the following materials will be reviewed: amalgam, liners and bases, and gold. The Dental Materials Course will provide the basic information regarding these materials. The restorative procedures will be performed primarily on typodont teeth mounted in a simulator. Extracted teeth with caries will also help students appreciate the different tactile responses of caries, dentin and enamel. There will be an emphasis on the following: the rationale for types of preparations and materials, indications and contraindications for different materials and types of restorations, and clinical problem solving related to operative dentistry in total treatment care.

REHE 263. Basic Procedure in Esthetics Lab. .5 Unit.

REHE 264. Endodontics. .5 Unit.
Introduction to methods and materials necessary for successful root canal therapy.

REHE 266. Partial Denture Design. 2 Units.
Recognition of clinical situations that require partial denture therapy are developed. Introduction to the terms used in removable partial prosthodontics. Partially edentulous casts diagnosed, designed, surveyed, contoured for path of insertion, prepared for rest seat areas, and finally tripped for further orientation by each student on his or her own casts. Thus the design, surveying, and clinical applications for removable partial service are presented in order to maintain optimal oral health conditions and to provide a sound basis for the prosthesis.

REHE 267. Prosthodontic Technology Lab. 2 Units.
Companion preclinical component to REHE 257. Each student constructs a complete set of dentures using laboratory manikin as patient. Although REHE 257 was conceived as a technique course, one of its principal objectives is to prepare the student for the clinical aspect of dental education.

REHE 268. Basic Procedures Competency. 1.5 Unit.
This course will build on the basic techniques learned in the previous basic procedure courses and aims to prepare the students for their clinical experience.

REHE 272. Basic Procedures in Operative Dentistry II Lab. 1 Unit.
Laboratory component of REHE 262.

REHE 274. Endodontics Lab. 1 Unit.
Companion laboratory component to REHE 264. Complete endodontic treatment performed by each student on extracted teeth using gutta percha.

REHE 276. Partial Denture Design Lab. 1.5 Unit.
Theories of removable partial denture construction which enable the student to perform exercises that are associated with the techniques used to achieve a successful result. Students will be evaluated by various testing methods.

REHE 351. Surgical Periodontics. 1 Unit.
Case analysis and treatment planning for various conditions of periodontal disease. Case presentation to patients. Basic surgical technique and advanced types of periodontal surgery demonstrated. Occlusal analysis and occlusal adjustment considered.

REHE 353. Principles of Treatment Planning II. 1 Unit.
This course provides formal instruction designed to prepare the students for patient management, practice management, and treatment planning. Emphasis on devising optimal, alternative and emergency diagnostic treatment plans.

REHE 355. Esthetic Dentistry. 1 Unit.
Lectures and demonstrations. The indications, contraindications, limitations, and use of modern techniques and materials in esthetic dentistry.

REHE 358. Dental Materials II. .5 Unit.
This is a didactic course that defines and describes properties, composition, indications and contraindications of uses of different dental materials.
REHE 360. Implant Dentistry. 1 Unit.
Didactic and laboratory instruction that introduces the concepts used in implantology. These include the scientific basis of implant tissue reactions, and the surgical and restorative protocols. Emphasis is placed on slide presentation of actual cases. An opportunity is given to students to place an implant in an artificial mandible and to manipulate implant components on a typodont.

REHE 362. Clinical Application of CAD/CAM Technologies. .5 Unit.
This course covers the criteria, techniques and practice of using CAD/CAM technologies in the clinical environment. In this course, emphasis will be on ceramic restorations made by Cerec (Sirona), as well as an introduction to different options of CAD/CAM machines available in the market. Students will be introduced to an advanced level of expertise in using the latest Cerec software in a variety of clinical applications. There will be also emphasis on the rationale for types of preparations and material selection based on the correct clinical indication.

REHE 400-1. Regional Board Preparation. .5 Unit.
The purpose of this course is to prepare the dental student to challenge a clinical licensing board examination. The students will be examined on the appropriate licensing board materials, and patient clinical activities. Students will be given formative feedback on typodont exercises as needed for their licensing examination.

REHE 400-2. Regional Board Preparation. .5 Unit.
The purpose of this course is to prepare the dental student to challenge a clinical licensing board examination. The students will be examined on the appropriate licensing board materials, and patient clinical activities. Students will be given formative feedback on typodont exercises as needed for their licensing examination.

REHE 413. Advanced Implant Dentistry I. 1 Unit.
This course is designed to expose the student to advance implant therapies for the dentate and edentulous patient. Through lectures and discussions the student will discover the multitude of variations of care available for these patients and the restorative processes necessary to deliver that care. They should also more fully understand the limitations of each of these modalities within the scope of dental implant therapy allowing them to provide for their patients the most appropriate treatment direction.

REHE 414. Advanced Implant Dentistry II. 1 Unit.
This course is a continuation of Advanced Implant Dentistry I and consists of a small group PBL Project where each group will be challenged with a patient requiring complex care. The group will be expected, utilizing all of their four years of training, to fully diagnose the patient's problems and create multiple treatment plans to assist the patient's return to oral health. They will finally present and defend their decision to the entire class and instructors.

REHE 421. Periodontal Medicine and Cases. 1 Unit.
Further application of the knowledge and skills learned in prior periodontal courses. Focus is on how selective periodontal treatment can be integrated into a treatment plan considering the parameters presented by a special situation. Some examples are treatment related to endodontics, prosthodontics, geriatrics, esthetics, orthodontics and implantology.

REHE 455. General Anesthesia, Oral Surgery. .5 Unit.

REHE 482. Orthodontics. 1 Unit.
Instruction through lectures and audio-visual programs enabling the student to gain judgment, knowledge, and skills to select and treat uncomplicated tooth irregularities in children and adults. Advanced topics in comprehensive orthodontics, such as surgical orthodontics and cleft-palate treatment.

REHE 488. Case Presentations I. 1 Unit.
First Semester of case presentation is dedicated to the review of comprehensive treatment planning slide material in preparation for National Boards part II and the Northeast Regional Board Dental Simulated Clinical Examination DSCE and the Case Based Examination (CBE) and the Western Regional Board (WREB) treatment planning examinations. Cases treated in the CASE SODM clinics will be reviewed by the preceptor faculty along with clinical specialty faculty and biological science faculty where appropriate. Diagnostic information will be on Blackboard preceding the schedule case review. During the case review questions will be presented for all students to interject through either the PRS format or Blackboard. In addition to the interactive format three disciplined based quizzes will be provided. The semester final will present a case based problem similar to the regional boards in which students identify the components of the diagnosis, treatment plan, treatment modifiers, treatment sequence and prognosis.

REHE 489. Case Presentations II. 1 Unit.
Second Semester. This course provides formal lecture presentations in the discipline of comprehensive dental care to assist students in the development of appropriate and successful diagnoses and treatment plans and the use of techniques and technology to achieve the goals of optimal dentistry. The course provides examples of cases in diagnosis and treatment planning in lecture, and include expertise from other departments in both the clinical and basic biological sciences. This course also provides the methodology for the treatment of moderate to severely mutilated dentitions and information regarding treatment modalities used related to the cases under discussion. The treatment plans are to be evidence based and used in concert with the outcomes of treatment. Techniques and Technology associated with the case shall be described as cases are reviewed. Both didactic lecture presentations and case reviews will utilize the interactive questioning and survey opportunities as needed through either the PRS format or Blackboard. The semester grade will be based on participation in the interactive sessions, a case based examination and each student is to turn in a fully documented senior case that is both diagnostic and treatment demanding. All cases will be approved prior to being considered as an acceptable senior case.

REMA Courses
REMA 261. Preclinical Orthodontics. 1 Unit.
Preclinical orthodontics includes relevant areas of applied growth and development, diagnostic methods and treatment planning. Topics included are: Histology and Physiology of Tooth movement and Laboratory Techniques related to the fabrication and use of suitable orthodontic appliances including material and biologic background necessary for proper clinical management of these appliances.
REMA 270. Introduction to Pediatrics. 1 Unit.
This course will provide instruction in the areas of preventive dentistry, restorative dentistry, pulp therapy, trauma, space maintenance and non-pharmacologic behavior management techniques for the pediatric patient. Particular attention will be paid to those areas that are essential in order to treat a pediatric patient appropriately. It is the hope that this course will communicate expectations and will provide significant preparation that will enhance the dental students’ clinical learning experience.

REMA 380. Introduction to Geriatric Dentistry. 1 Unit.
This course focuses on the study of aging in the population and its effects on treatment planning and actual dental treatment of geriatric patients from well to frail. Didactic instruction and case presentations would cover a wide variety of medically compromising conditions, physical disabilities and sensory impairments. The effects of these conditions as they pertain to dentistry will be discussed together with economic, social and community variables that need to be addressed to achieve rational dental care.
SCHOOL OF LAW

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Founded in 1892, the Case Western Reserve University School of Law (http://law.case.edu) is a charter member of the Association of American Law Schools and of the national law honorary society, the Order of the Coif. It was among the first law schools accredited by the American Bar Association.

The school has a student body of about 500 and a full-time faculty of about fifty. In the school's early years, most students came from Ohio and remained in Ohio after graduation. Today, students come from all parts of the country, and there are CWRU law graduates in virtually every state (and in several foreign countries), and certainly in every major U.S. city. An active and aggressive Career Services Office works with students, graduates, and prospective employers from all over the nation to maximize job opportunities.

The Judge Ben C. Green Law Library

The law library's holdings include more than 410,000 books and volume-equivalents, complete collections of federal and state law, law reviews, current law services, an extensive British and Commonwealth collection, and special collections in taxation, labor law, foreign investments, international law, and environmental law. The law library is building strong collections in law and medicine, intellectual property, and law of the European Union. It is a selective depository for both U.S. and Canadian government documents. There are computer facilities on every floor of the library, providing access to more than 700 electronic services and library catalogs, and a wide range of software services. The university boasts a fast and powerful computing network and wireless access, and the university network links the law school to the vast resources of the Internet. The law library is a member of OhioLINK, which is a consortium of Ohio's college and university libraries and the State Library of Ohio. OhioLINK offers access to more than 31 million library items from 79 institutions. These materials include items from law, medical, and special collections.

The law library offers its users access to an ever-expanding list of electronic research databases as well as e-books. Electronic resources are accessible through the library catalog and the Law Library Services page on our website. Web-based databases offered include Lexis/Nexis and Westlaw as well as over 100 OhioLINK databases (including Index to Legal Periodicals and Medline). Many of these OhioLINK databases contain the full text of journal articles. Housed within the law library are a computer laboratory and a computer training classroom.

Special Programs

Litigation Program

Since the mid-1970s, the School of Law has invested heavily in its litigation program. Students practice the basic skills of trial advocacy in such courses as LAWS 6110 Trial Tactics, LAWS 6111 Appellate Practice, and in the co-curricular moot court and mock trial programs.

Study Abroad

The JD program in the law school offers a number of opportunities for students to engage in comparative legal study. The opportunities range from formal semester abroad programs (the School of Law has cooperative agreements with over 16 schools in Canada, Latin America, Europe, and Asia, allowing students to study at the host school for a semester and transfer the completed credits to the CWRU JD program), to various summer study programs, as well as the Case Abroad at Home program, which brings foreign scholars to our campus to offer special one-week intensive courses immediately prior to the start of the fall term each year.

Student Activities

Publications

The School of Law publishes three scholarly journals, all student-edited. The oldest is the Case Western Reserve Law Review. The Journal of International Law is an academic journal specializing in research in the areas of international and comparative law. Health Matrix: Journal of Law-Medicine began as a joint undertaking of all six of the university's professional schools but since 1990, has been sponsored solely by the law school and its Law-Medicine Center.

Competitions

Moot Court

A student board administers the Dean Dunmore Moot Court Competition, a year long program in which second-year students participate after completing the Appellate Practice course. It culminates in a round-robin tournament involving 16 finalists. From those finalists, the executive board and faculty advisors select teams that will compete the following year in external moot-court competitions (currently the National Moot Court Competition and the ABA's National Appellate Advocacy Competition.) Case Western Reserve also enters the Jessup International Competition, the International Criminal Court Competition, and the Vis International Arbitration Competition; those teams are selected by the faculty coaches in a joint intramural try-out competition in the fall.

Mock Trial

The Jonathan M. Ault Mock Trial Board sponsors the Case Classic, an invitational competition involving law schools from places as diverse as Ohio, Kentucky, West Virginia, Michigan, Indiana, and Alabama. The Case Classic provides a competitive and collegial environment for multiple teams to tune up for the Spring competition season. Currently, the law school sends team to the National Trial Competition, the National Student Trial Competition of the Association of Trial Lawyers of America, and a competition sponsored by the Academy of Trial Lawyers of Allegheny County, Pennsylvania.

Regulations and Rules of Conduct

The Academic Regulations of the School of Law are provided to each student upon matriculation through the law school's website.

In addition to the university's rules of conduct, law students are expected to comply with the American Bar Association's Model Code of Professional Responsibility and Model Rules of Professional Conduct, to the extent that these are applicable, and with the law school's own Code of Conduct. The Model Code and Model Rules are available in the law library. The school's Code of Conduct, like the Academic Regulations, is provided to each student upon matriculation through the law school's Intranet website.

Regular class attendance, a high degree of preparation for class, a high degree of participation in class discussions, and diligent execution of class exercises or assignments are required of every student. At the option of the instructor and after notification to the student, one who...
violates this regulation shall be withdrawn from the course, and the grade WF shall be entered on the student’s transcript.

**Academic Centers**

**Milton A. Kramer Law Clinic Center**
The Supreme Court of Ohio authorizes student practice under attorney supervision in the final year of law school. Through the clinic, students provide legal representation to indigent clients and community groups and receive academic credit. The supervising attorneys are full-time members of the law faculty. The clinical program is the capstone of the skills curriculum and offers specialized practice experiences in Criminal Justice, Community Development, Civil Litigation Practice, focused on consumer matters, predatory lending, social security disability, and other public benefit issues, Immigration, Health Law, and Family Law.

**Center for Business Law and Regulation**
To better prepare its students and future leaders with a thorough understanding of the business issues facing entrepreneurs, entities, and other clients, the School of Law created the Center for Business Law and Regulation. The center focuses on expanding curricular offerings and programs as well as engaging in opportunities for legal, empirical, and interdisciplinary research, assessing the role and impact of government in the regulation of business. The center will also host special lectures and symposia to highlight topics in business law and foster public debate and inquiry regarding business regulation.

**Spangenberg Center for Law, Technology and the Arts**
The Spangenberg Center for Law, Technology, and the Arts was established as an internationally recognized forum for the interdisciplinary study of law, technology, and the arts. The Center focuses on teaching, research, and programs pertaining to intellectual property, technological innovation and technology transfer, the intersection of science, economics, philosophy, and the law, legal issues concerning biotechnology and computer technologies, and laws and cultural issues relating to the creative arts. Through the Center, the law school is able to offer students opportunities to address important, topical issues relating to law and technology and law and the arts through a variety of courses, lectures, events, and symposia.

**Frederick K. Cox International Law Center**
The Cox International Law Center serves as the stimulus for enhancing programs in international, comparative, and transnational law at the law school. It supports visiting scholars and visiting faculty at the law school to enrich the curriculum and research capacity of the resident faculty. It also supports the development of international information resources. Through a series of sister law school relationships, it seeks to attract foreign students to the law school and provide opportunities for Case Western Reserve law students to study abroad; it also provides opportunities for faculty to study and teach abroad.

**Institute for Global Security Law and Policy**
The events and aftermath of 9/11 have made security and counter-terrorism fundamental, if not defining, concerns for the world community, nations, companies, the legal system, and individuals. The institute for Global Security Law and Policy was created in 2005 to provide a uniquely comprehensive hub for addressing the legal, financial, political, social, religious and cultural ramifications of counterterrorism, using an innovative multifaceted approach that integrates theory with practical application. The Institute develops and integrates the best learning from the academic and the real world and draws on numerous disciplines and experiences to provide innovative and world class programs, research, teaching, and service on the issues of security and counter-terrorism. The work of the Institute serves as an invaluable resource to governments, businesses, organizations, the legal profession, and the general community.

**Canada-United States Law Institute**
The Canada-U.S. Law Institute, established in 1976, is jointly sponsored by the law schools of Case Western Reserve University and the University of Western Ontario. Its primary educational purpose is to give students of both schools a comparative perspective on their own country’s legal system. Each semester, up to six students from each school spend the term in residence at the other school. The school in which the student is a degree candidate gives full credit for the semester’s work. The two schools also exchange faculty, usually for periods of one or a few days, but occasionally to teach one or more courses for a full semester.

A second purpose of the institute is to provide a framework for the exploration of transnational and international legal issues affecting the relationship between Canada and the United States. In addition to the regularly scheduled courses on Canadian-U.S. topics, the institute sponsors workshops and conferences, including annual conferences in Cleveland, which, in recent years, have dealt with Canadian-U.S. economic ties.

The institute also sponsors a regular publication, the Canada-U.S. Law Journal; the annual Niagara Moot Court Competition, in which students from U.S. and Canadian law schools participate; and special research projects, often with funding support.

**Financial Integrity Institute**
The mission of the Financial Integrity Institute is to advance financial integrity globally by conducting and promoting at the highest standards research, education, and professional excellence in anti-money laundering and countering the financing of terrorism, targeted sanctions, anti-corruption, and international tax evasion policies and practices. The Institute has also recently launched a Master of Arts in Financial Integrity program at the School of Law.

**Law-Medicine Center**
The Law-Medicine Center at Case Western Reserve University has been in operation for over 50 years. It began with a focus on forensic medicine, but has broadened to include the whole range of legal, social, economic, scientific, and ethical issues in which law and medicine are interrelated. Besides the regular course offerings, the center frequently presents lectures, symposia, and workshops, and sponsors major conferences. It publishes a student-edited journal, Health Matrix: Journal of Law-Medicine. Participants in the center’s activities include not only university personnel, but also professionals from such institutions as University Hospitals of Cleveland and the Cleveland Clinic.

**Center for Cyberspace Law and Policy**
The Center for Cyberspace Law and Policy is devoted to studying the creation, dissemination, and acquisition of human thought, creativity and information in the digital age. Through scholarship, teaching, and bringing together leading thinkers, the Center evaluates the laws, policies, and social forces that govern issues once limited to the Internet, but that are now commonplace in a world networked and mediated by digital technology.

**Center for Professional Ethics**
The center’s mission is to explore moral choices across professional lines in a variety of disciplines. It brings together practicing professionals, faculty and students to exchange ideas on such topics as confidentiality, decision-making, lying and conflict of interest. The Center for Professional Ethics was founded in 1978 by Robert P. Lawry, who retired
from the law faculty in 2007, and Robert W. Clarke, retired Director of Case Western Reserve University's Christian Movement. The center is supported by the David and Katherine Ragone Endowment Fund. The center plans to continue to draw upon its founding principles to expand its inter-disciplinary approach and put academic work into practice.

**Administration**

Jessica Willen Berg, JD (Cornell University), MPH (Case Western Reserve University)
Co-Dean

Michael P. Scharf, JD
(Duke University)
Co-Dean

Alyson Suter Alber, JD
(University of Virginia)
Associate Dean for Enrollment Planning and Strategic Initiatives

Kelli C. Curtis, JD
(Ohio State University)
Associate Dean for Admissions

B. Jessie Hill, JD
(Harvard University)
Associate Dean for Academic Affairs

Judith P. Lipton, JD, MSW
(University of Connecticut)
Associate Dean for Experiential Education

Sarah McFarlane Polly, JD
(Ohio State University)
Associate Dean for Student Services and Career Development

Ruqaijah A. Yearby, JD (Georgetown University), MPH (Johns Hopkins University)
Associate Dean for Institutional Diversity and Inclusiveness

Joseph A. Custer, JD (University of Arkansas), MLIS (University of Missouri - Kansas City)
Director, The Judge Ben C. Green Law Library

James M. Pasch, JD
(Case Western Reserve University)
Assistant Dean of Development

Mary Beth Moore, JD
(Cleveland State University)
Assistant Dean of Career Development

**Juris Doctor (JD)**

**Juris Doctor**

The School of Law offers the Juris Doctor (JD) degree as well as several dual-degree programs. The JD degree requires successful completion of 88 credit hours, of which 44 hours are in specified required courses, at least 2 credits in the writing of a substantial research paper, 8 hours of an experiential capstone project, and at least 34 elective credits. The first year program for the JD degree consists mainly of the required basic courses.

### Required First Year Courses

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Contracts (LAWS 1101)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criminal Law (LAWS 1102)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Torts (LAWS 1103)</td>
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<td></td>
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<tr>
<td>Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil Procedure (LAWS 1201)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property (LAWS 1203)</td>
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<tr>
<td>Law, Legislation and Regulation (LAWS 1204)</td>
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</tr>
<tr>
<td>Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 2</td>
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<tr>
<td>Year Total:</td>
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Total Units in Sequence: 30

### Required Second and Third Year Courses

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<th>Course Code</th>
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<tr>
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<td>Constitutional Law I</td>
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<tr>
<td>LAWS 2001</td>
<td>Professional Responsibility</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 2803</td>
<td>Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 3: Advanced Skills</td>
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</table>

Completion of substantial research paper 2 - 3
Experiential learning credits (includes experiential capstone project) 12
Experiential Capstone during final year 4 - 8
Total Units 28-33

### Curricular Concentrations

Seven curricular concentrations are offered for the Juris Doctor. These optional concentrations allow students to provide a concentrated focus for some of their elective coursework. The current available curricular concentrations are:

- Business Law
- Criminal Law
- Litigation / Alternative Dispute Resolution
- Health Law
- International Law
- Law, Technology, and the Arts
- Public Law

### Elective courses

In addition to the required courses and the optional curricular concentrations, all students must take open elective courses in order to earn a minimum of 88 credits of law school coursework to qualify for the Juris Doctor degree. All students must enroll for a full-time course load each semester (10-18 credits), and must complete at least six regular semesters of full-time coursework. Optional summer courses may be used to reduce the credit load during a regular semester, but the student must still complete at least six regular full-time semesters (summer does not count as a regular semester.) Students may choose to take one open elective course under a "Pass/No Entry" credit basis, wherein the grade
earned for the course is converted to a Pass or No Entry, and the course doesn't affect the student's grade point average.

**Graduate School Option**
Students in the School of Law who are not enrolled in a dual-degree program may take up to nine hours of approved courses in the other graduate and professional schools of Case Western Reserve University and have such courses counted as elective credit toward the JD degree. Such coursework must be graduate-level coursework, and must be closely related to the study of law and the student's educational/career objectives.

**Academic Regulations**
A complete list of Academic Regulations for the Juris Doctor program are contained in the Law Student Handbook. Questions can be directed to the law school's Academic Services Office.

**Class Attendance Policy**
JD students are required to attend all class sessions for which they are registered. Instructors will provide details of their procedures and policies regarding class absence at the beginning of the course. Students who fail to meet responsibilities for class attendance and preparation are subject to dismissal from a course by the Instructor. Students dismissed from a course will receive a grade of WF for the course and will not be eligible to take the exam or complete the work in the class.

**JD Curricular Concentrations**
JD students have an option to earn a curricular concentration by focusing their course selections within a particular area of legal study. Requirements for each particular concentration are listed below. In order to receive the concentration, students must earn at least 15–18 credits (varies by the specific concentration) in courses within the concentration, and earn an overall grade point average of 3.000 or higher amongst all courses defined by that concentration. Each concentration has a number of prescribed required courses, along with a menu of courses that can counted as elective hours. Each concentration also has a writing requirement (a substantial research paper on a topic applicable to the concentration) and a capstone experience requirement (related to the concentration). Specific courses applicable to each concentration are subject to change by faculty review. **NOTE: New concentration standards have been developed as part of the revised JD curriculum, so students will have differing requirements based on when they first began the study of law. All current students must obtain the relevant concentration curriculum sheet which applies to them from the Law School Academic Services Office. Each concentration has an assigned faculty leader who can assist students with course selection and curriculum planning.**

**Business Law**

*Required Courses*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>LAWS 4401</td>
<td>Business Associations</td>
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</tr>
<tr>
<td>LAWS 5431</td>
<td>Securities Regulation</td>
<td>3</td>
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*Elective Courses*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>LAWS 5412</td>
<td>Advanced Securities Regulation</td>
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<tr>
<td>LAWS 5417</td>
<td>Business, Capital Markets, and the Role of Lawyers</td>
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</tr>
<tr>
<td>LAWS 6012</td>
<td>Community Development Clinic II</td>
<td></td>
</tr>
<tr>
<td>LAWS 5403</td>
<td>Federal Taxation of Corporation and Partnerships</td>
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**Criminal Law**

*Required Courses*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>LAWS 4807</td>
<td>Criminal Procedure I</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 5718</td>
<td>Criminal Procedure II</td>
<td>2</td>
</tr>
<tr>
<td>LAWS 4808</td>
<td>Evidence</td>
<td>4</td>
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*Elective Courses*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>LAWS 6111</td>
<td>Appellate Practice</td>
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</tr>
<tr>
<td>LAWS 5113</td>
<td>Counterterrorism Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 6022</td>
<td>Criminal Justice Clinic II</td>
<td></td>
</tr>
<tr>
<td>LAWS 5213</td>
<td>Psychiatry &amp; Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 5721</td>
<td>Death Penalty Lab</td>
<td></td>
</tr>
<tr>
<td>LAWS 5722</td>
<td>Death Penalty Lab II</td>
<td></td>
</tr>
<tr>
<td>LAWS 5121</td>
<td>International Criminal Law and Procedure</td>
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<tr>
<td>LAWS 5116</td>
<td>International Human Rights</td>
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<tr>
<td>LAWS 5736</td>
<td>Juvenile Law</td>
<td></td>
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<tr>
<td>LAWS 6108</td>
<td>Pretrial Practice: Criminal</td>
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</tr>
<tr>
<td>LAWS 5749</td>
<td>Prisoner Rights &amp; Litigation</td>
<td></td>
</tr>
<tr>
<td>LAWS 5751</td>
<td>Scientific Evidence in Criminal Litigation</td>
<td></td>
</tr>
<tr>
<td>LAWS 5919</td>
<td>Scientific Evidence and Advanced Research</td>
<td></td>
</tr>
<tr>
<td>LAWS 6110</td>
<td>Trial Tactics</td>
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</tr>
<tr>
<td>LAWS 5118</td>
<td>International Law Research Lab</td>
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<tr>
<td>LAWS 5925</td>
<td>Wrongful Convictions Seminar</td>
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**Total Units: 16**

**Litigation / Alternative Dispute Resolution**

*Required Courses*

<table>
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<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>LAWS 4808</td>
<td>Evidence</td>
<td>4</td>
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*Elective Courses*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>LAWS 4806</td>
<td>Administrative Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 6103</td>
<td>Basic Mediation Training</td>
<td></td>
</tr>
<tr>
<td>LAWS 5212</td>
<td>Civil Law and Psychiatry</td>
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</tr>
<tr>
<td>LAWS 5714</td>
<td>Complex Litigation</td>
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</tr>
<tr>
<td>LAWS 5716</td>
<td>Conflict of Laws</td>
<td></td>
</tr>
<tr>
<td>LAWS 5313</td>
<td>Copyright and Trademark Litigation</td>
<td></td>
</tr>
<tr>
<td>LAWS 5213</td>
<td>Psychiatry &amp; Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 4807</td>
<td>Criminal Procedure I</td>
<td></td>
</tr>
<tr>
<td>LAWS 5718</td>
<td>Criminal Procedure II</td>
<td></td>
</tr>
<tr>
<td>LAWS 5720</td>
<td>Death Penalty Law and Process</td>
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<tr>
<td>LAWS 5726</td>
<td>Employment Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 5729</td>
<td>Expert Testimony in Civil Cases</td>
<td></td>
</tr>
<tr>
<td>LAWS 5731</td>
<td>Federal Courts</td>
<td>3</td>
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<tr>
<td>LAWS 5734</td>
<td>Immigration Law II</td>
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**Total Units: 12**

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**Required Courses**

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<tr>
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<tr>
<td>LAWS 5421</td>
<td>Financial Principles for Lawyers</td>
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</tr>
<tr>
<td>LAWS 5120</td>
<td>International Business Transactions</td>
<td></td>
</tr>
<tr>
<td>LAWS 5427</td>
<td>Mergers and Acquisitions</td>
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</tr>
<tr>
<td>LAWS 5434</td>
<td>Secured Transactions</td>
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<tr>
<td>LAWS 5422</td>
<td>Financial Markets: Law, Theory, and Practice</td>
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</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Units</td>
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<tr>
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<tr>
<td>LAWS 5115</td>
<td>International Arbitration</td>
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<tr>
<td>LAWS 5122</td>
<td>Transnational Litigation</td>
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<tr>
<td>LAWS 5428</td>
<td>Products Liability</td>
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<tr>
<td>LAWS 5751</td>
<td>Scientific Evidence in Criminal Litigation</td>
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<tr>
<td>LAWS 5919</td>
<td>Scientific Evidence and Advanced Research</td>
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<tr>
<td>LAWS 5763</td>
<td>White Collar Crime: Prosecution and Defense</td>
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<tr>
<td>LAWS 5925</td>
<td>Wrongful Convictions Seminar</td>
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<tr>
<td>LAWS 5707</td>
<td>Alternative Dispute Resolution</td>
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<tr>
<td>LAWS 6111</td>
<td>Appellate Practice</td>
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<tr>
<td>LAWS 5721</td>
<td>Death Penalty Lab</td>
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<tr>
<td>LAWS 5722</td>
<td>Death Penalty Lab II</td>
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<tr>
<td>LAWS 6550</td>
<td>Mock Trial</td>
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<tr>
<td>LAWS 6107</td>
<td>Pretrial Practice: Civil</td>
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</table>

**Total Units:** 19

* or any clinic course except Community Development.

** must take at least one Doctrinal and one Practice course

+ 4 credits of any clinical course except Community Development may be taken as Practice Courses

---

### Health Law

**Required Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>LAWS 4201</td>
<td>Health Law 1</td>
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</tr>
<tr>
<td>LAWS 4202</td>
<td>Health Law 2</td>
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One of the following: 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>LAWS 4401</td>
<td>Business Associations</td>
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</tr>
<tr>
<td>LAWS 4808</td>
<td>Administrative Law</td>
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**Elective Courses**

<table>
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<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>LAWS 4200</td>
<td>Bioethics and Law</td>
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<td>LAWS 5212</td>
<td>Civil Law and Psychiatry</td>
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<td>LAWS 5213</td>
<td>Psychiatry &amp; Law</td>
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<td>LAWS 5723</td>
<td>Disability Law</td>
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<td>LAWS 5724</td>
<td>Discrimination in Employment</td>
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<tr>
<td>LAWS 5729</td>
<td>Expert Testimony in Civil Cases</td>
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<tr>
<td>LAWS 5203</td>
<td>Food And Drug Law</td>
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<tr>
<td>LAWS 5204</td>
<td>Genetics and Law</td>
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<tr>
<td>LAWS 5219</td>
<td>Health Care Transactions</td>
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</tr>
<tr>
<td>LAWS 6032</td>
<td>Health Law Clinic II</td>
<td></td>
</tr>
<tr>
<td>LAWS 6513</td>
<td>Health Matrix ((Editors))</td>
<td></td>
</tr>
<tr>
<td>LAWS 6503</td>
<td>Health Matrix Seminar</td>
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<tr>
<td>LAWS 6106</td>
<td>Pretrial Practice: Medical Malpractice</td>
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<tr>
<td>LAWS 5205</td>
<td>Public Health Law</td>
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<td>LAWS 5918</td>
<td>Reproductive Rights Lab</td>
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<td>LAWS 5225</td>
<td>Research Ethics and Regulation</td>
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<tr>
<td>LAWS 5751</td>
<td>Scientific Evidence in Criminal Litigation</td>
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**Total Units:** 18

* Must include at least one course from Public Int’l Law and at least one course from Int’l Bus Law

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### International Law

**Required Courses**

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<tr>
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<th>Course Title</th>
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<tbody>
<tr>
<td>LAWS 4806</td>
<td>Administrative Law</td>
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<tr>
<td>LAWS 4401</td>
<td>Business Associations</td>
<td></td>
</tr>
<tr>
<td>LAWS 4808</td>
<td>Evidence</td>
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**Elective Courses**

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<th>Course Title</th>
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<tr>
<td>LAWS 5733</td>
<td>Immigration Law</td>
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<td>LAWS 6101</td>
<td>Immigration Law Practicum I</td>
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<tr>
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</tr>
<tr>
<td>LAWS 5116</td>
<td>International Human Rights</td>
<td></td>
</tr>
<tr>
<td>LAWS 5136</td>
<td>International Humanitarian Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 5118</td>
<td>International Law Research Lab</td>
<td></td>
</tr>
<tr>
<td>LAWS 5125</td>
<td>Jewish Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 5745</td>
<td>Foreign Affairs Law</td>
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</tr>
</tbody>
</table>

International Business Law electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAWS 5111</td>
<td>Admiralty Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 5112</td>
<td>Canada-United States Law Institute Seminar</td>
<td></td>
</tr>
<tr>
<td>LAWS 5716</td>
<td>Conflict of Laws</td>
<td></td>
</tr>
<tr>
<td>LAWS 5314</td>
<td>Cyberlaw</td>
<td></td>
</tr>
<tr>
<td>LAWS 5114</td>
<td>European Union Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 5122</td>
<td>Transnational Litigation</td>
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</tr>
</tbody>
</table>

**Total Units:** 16

* Must include at least one course from Public Int’l Law and at least one course from Int’l Bus Law

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### Law, Technology, and the Arts

**Required Courses** (at least 2 of the following)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAWS 4301</td>
<td>Copyright Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 5314</td>
<td>Cyberlaw</td>
<td></td>
</tr>
<tr>
<td>LAWS 4302</td>
<td>Patent Law</td>
<td></td>
</tr>
<tr>
<td>LAWS 4303</td>
<td>Trademark Law</td>
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</tr>
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</table>

**Elective Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAWS 5728</td>
<td>ePayment Systems</td>
<td></td>
</tr>
<tr>
<td>LAWS 5315</td>
<td>Entertainment Law</td>
<td></td>
</tr>
<tr>
<td>ENGL 525</td>
<td>Intellectual Property and the Construction of Authorship</td>
<td></td>
</tr>
<tr>
<td>LAWS 5322</td>
<td>Intellectual Property &amp; Dealmaking</td>
<td></td>
</tr>
<tr>
<td>LAWS 5323</td>
<td>Intellectual Property Strategy</td>
<td></td>
</tr>
<tr>
<td>LAWS 4300</td>
<td>Intellectual Property Survey</td>
<td></td>
</tr>
<tr>
<td>LAWS 5363</td>
<td>Intellectual Property Theory Seminar</td>
<td></td>
</tr>
<tr>
<td>LAWS 5318</td>
<td>Intellectual Property Licensing</td>
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</tr>
<tr>
<td>LAWS 5319</td>
<td>International Intellectual Property</td>
<td></td>
</tr>
<tr>
<td>LAWS 5739</td>
<td>Law of Archeological Relics</td>
<td></td>
</tr>
<tr>
<td>LAWS 5324</td>
<td>Law of the Music Industry</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units:** 6

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### Practice electives **+

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAWS 5707</td>
<td>Alternative Dispute Resolution</td>
<td></td>
</tr>
</tbody>
</table>

---

* Must include at least one Doctrinal and one Practice course

---

**+** 4 credits of any clinical course except Community Development may be taken as Practice Courses
Dual Degree Programs

For students in dual degree programs, 12 hours of elective credits in the JD program are waived in consideration of completion of the dual degree. Students must be separately admitted to both degree programs in order to pursue a dual degree, the qualitative requirements of both degrees must be fully met, and the two degrees must be earned simultaneously. Students must begin coursework in the second degree program prior to beginning the fifth semester of law school work. Also, no coursework
completed prior to official matriculation in the law school may be counted towards the law school degree.

**JD/MBA (Master of Business Administration)**

Students may complete the three-year JD program and the two-year MBA program in four academic years by completing 133 credit hours (including a 7-credit-hour overload which can be taken during the academic year or during the summer semester).

The School of Law allows dual degree students to use 12 credit hours from the MBA to fulfill both JD and MBA requirements. The Weatherhead School of Management allows dual degree students to use 12 credit hours from the School of Law to fulfill both MBA and JD requirements. Students must achieve a grade of C or better to receive double credit for the courses. This reduces the total number of hours required for the two degrees by 24 credit hours.

JD/MBA students may enroll only on a full-time basis, except during summer sessions. Dual degree students must receive both the JD and the MBA degrees simultaneously upon completion of degree requirements at both schools in order to receive the 24 hours of cross-credits described above.

Throughout the dual degree program, JD/MBA students continue to register in the first school they attended. After completion of both degree programs, two separate diplomas are awarded. Course work for both programs must be completed within six years of the date of initial enrollment in either program.

**JD/MA or JD/MS (Master of Arts or Master of Science)**

Enrolling in both the School of Law and the School of Graduate Studies, a student complete a Juris Doctor (JD) and a Master of Arts (MA) or Master of Science (MS) degree and earn the two degrees in seven semesters or six semesters plus two summers. Law students enrolled in a dual JD/MA degree program may earn up to 12 credits toward the JD in graduate level courses. Current options for this dual degree are:

- MA – Art History and Museum Studies
- MA - Bioethics
- MA - Legal History
- MA - Political Science
- MS – Biochemistry

**JD/MSSA (Master of Science in Social Administration)**

A dual degree program established by the Mandel School of Applied Social Sciences and the School of Law makes it possible for selected full-time students to pursue an integrated program of studies and receive the MSSA and JD degrees within four years rather than the normal five years that would be required to earn the two degrees separately. Law students enrolled in the dual JD/MSSA program may earn up to 12 credits toward the JD in graduate level MSSA courses. Applicants for the dual degree program must apply to and meet the admission requirements of both professional schools and are encouraged to apply for admission to both programs simultaneously.

Dual degree students must receive the MSSA and JD degrees simultaneously to be granted credit for specific courses taken in the other program.

**JD/MD (Doctor of Medicine)**

The School of Law and the School of Medicine offer a specialized dual degree program that allows a student to complete both degrees in six years. Law students enrolled in the dual JD/MD degree program may earn up to 12 credits toward the JD in graduate level MD courses. A student who begins at the law school spends two years studying law, then four years studying medicine. Alternatively, a student may spend the first two years and the last two years at the medical school, and the two middle years at the law school.

**JD/MPH (Master of Public Health)**

The MPH degree will generally add a year of additional course work to the JD degree, creating a four-year program. Law students enrolled in the dual JD/MPH degree program may earn up to 12 credits toward the JD in graduate level MPH courses. The law school offers several health law courses that meet the MPH elective requirements.

**Graduate Law Programs**

**Programs for foreign-educated lawyers**

Three different Master of Laws (LLM) programs are offered to students who have completed legal training outside of the United States. These programs allow students to spend one year in an intensive study program to gain exposure and immersion into the legal theory and practices of the U.S., and to engage in comparative study of the U.S. and other international legal systems. Building on a base of required courses specific to the International LLM programs, each student will develop an individual plan of study leading to a Master of Laws degree in general United States and Global Legal Studies, or the more focused fields of Intellectual Property Law or International Business Law. Students in the general United States and Global Legal Studies program have the option to pursue a particular curricular concentration by consulting with the director of Foreign Graduate Studies and choosing a focus area in their elective courses.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAWS 4901</td>
<td>Foreign Graduate Seminar</td>
<td>2</td>
</tr>
<tr>
<td>LAWS 4903</td>
<td>U.S. Contract Law</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 4912</td>
<td>U.S. Legal Research, Writing, and Analysis</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Elective courses as specified by chosen academic plan</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>and approved by program director</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Units</td>
<td>24</td>
</tr>
</tbody>
</table>

The specialized LLM degrees have additional required courses in the applicable specialty area. Each LLM student’s course of study will be determined by the program director in consultation with the student and will be based on the student’s prior legal education, goals, and interests. After completion of the degree requirements, students may elect to spend a summer internship with a law firm or corporate legal department in the United States. Further information and admission materials may be requested from the Foreign Graduate Studies Program office. (http://law.case.edu/Academics/Degrees/LLM)

**Doctor of Juridical Science**

The Doctor of Juridical Science (SJD) offers advanced academic study of law for students who hold either a JD degree or an equivalent professional law degree from a country outside of the USA, and some promise for advanced academic study. The SJD program is highly individualized and tailored to the student’s aspirations. The program will train graduates for positions of leadership in academia, research or policy making. Students will spend at least two semesters in advanced coursework, as determined by the student’s graduate program adviser. The student will then undertake significant research resulting in the writing of a doctoral dissertation under the supervision
School of Law Faculty

International Criminal Law
The Master of Laws (LLM) program in International Criminal Law is a one-year advanced study program to students who hold the JD degree from a U.S. law school, or equivalent training from a school outside of the USA. It provides students with an in-depth knowledge of international criminal law and procedure, international humanitarian law, and national security law, and will equip them to practice international criminal law before international tribunals or national courts. Students will plan their course of study by working closely with the Program Director. Selected students will also have the opportunity to participate in one of our International Criminal Tribunal Externships during one of their semesters in the program.

Ancillary Programs
In addition to the legal training programs, the School of Law offers two programs that are targeted to other professionals who seek advanced training in a specific area of law, but do not have a prior degree in law.

Executive Master of Arts in Financial Integrity
This program is intended for professionals who design and implement anti-money laundering, counter-terrorism, counter-proliferation financing policies and related integrity initiatives. Taught by leading academics and practitioners from around the world, the MAFI program is the first of its kind offered by a major research university. The program is offered on a part-time, year-round basis over 16 months through a series of intensive, three day weekend session meeting once every month. The program is 30 credits, consisting of 6 required courses, one elective, and a required capstone research project.

More details on the program are available on the program website (http://law.case.edu/Academics/Degrees/Masters-in-Financial-Integrity).

Master of Arts in Patent Practice
The Masters in Patent Practice is designed to prepare students for careers as patent agents. Students must be eligible to sit for the patent bar exam, which requires an undergraduate degree in engineering, computer science, or a physical or biological degree. This degree is a viable alternative for students who want to pursue a career in patent practice without having to take the full 3-year JD.

More details of the program may be found on the program website (http://law.case.edu/Academics/Degrees/Masters-in-Patent-Practice).

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAWS 4300</td>
<td>Intellectual Property Survey</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 4302</td>
<td>Patent Law</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 4315</td>
<td>Patent Agent Lab</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 4820</td>
<td>Patent Bar Review</td>
<td>4</td>
</tr>
<tr>
<td>LAWS 5341</td>
<td>Commercialization and Intellectual Property Management</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 4311</td>
<td>Patent Preparation and Prosecution</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 4312</td>
<td>Patent Preparation and Prosecution</td>
<td>2</td>
</tr>
</tbody>
</table>

Electives 9
Total Units 30

School of Law Faculty

http://law.case.edu/

School of Law Faculty

Jonathan H. Adler, JD
(George Mason University)
Johan Verheij Memorial Professor of Law; Director of the Center for Business Law and Regulation

Michael J. Benza, JD
(Case Western Reserve University)
Senior Instructor in Law

Jessica Wilen Berg, JD, MPH
(Cornell University; Case Western Reserve University)
Dean; Tom J.E. and Bette Lou Walker Professor of Law; Professor of Bioethics & Public Health

Jaime Bouvier, JD
(Case Western Reserve University)
Assistant Professor of Lawyering Skills

David J. Carney, JD
(University of Michigan)
Professor of Lawyering Skills

Juscelino F. Colares, JD, PhD
(Cornell University; University of Tennessee)
Schott-van den Eynden Professor of Law; Associate Director of the Frederick K. Cox International Law Center

Avidan Y. Cover, JD
(Cornell University)
Associate Professor of Law; Director of the Institute for Global Security Law & Policy

Joseph A. Custer, JD, MLIS
(University of Arkansas; University of Missouri-Kansas City)
Associate Professor of Law & Director, Judge Ben C. Green Law Library

Carol T. Fox, JD, PhD
(Case Western Reserve University)
Senior Instructor in Law

Peter M. Gerhart, JD
(Columbia University)
Professor of Law

Jonathan C. Gordon, JD
(Columbia University)
Professor of Lawyering Skills

Richard K. Gordon, JD
(Harvard University)
Professor of Law,Director of the Financial Integrity Institute; Associate Director of the Frederick K. Cox International Law Center
Maureen Guirguis (Kenny), JD  
(Cleveland State University)  
Professor of Law; Co-Director of the Human Trafficking Law Clinic

Ayesha Bell Hardaway, JD  
(Case Western Reserve University)  
Assistant Professor of Law

B. Jessie Hill, JD  
(Harvard University)  
Professor of Law

Sharona Hoffman, JD, LLM  
(Harvard University; University of Houston)  
Edgar A. Hahn Professor of Law; Professor of Bioethics; Co-Director of the Law-Medicine Center

Daniel A. Jaffe, JD  
(Columbia University)  
Professor of Lawyering Skills

Lewis R. Katz, JD  
(Indiana University)  
John C. Hutchins Professor of Law, Director of Foreign Graduate Legal Studies

Charles R. Korsmo, JD  
(Yale University)  
Associate Professor of Law

Juliet P. Kostritsky, JD  
(University of Wisconsin)  
Everett D. and Eugenia S. McCurdy Professor of Contract Law

Raymond Shih Ray Ku, JD  
(New York University)  
Professor of Law; Director, Center for Cyberspace Law & Policy

Judith P. Lipton, JD, MSW  
(University of Connecticut)  
Honorable Blanche E. Krupansky and Frank W. Vargo Jr. Professor of Law

Kevin J. McMunigal, JD  
(University of California, Berkeley)  
Professor of Law

Laura E. McNally-Levine, JD  
(Syracuse University)  
Professor of Law; Director of the Milton A. Kramer Law Clinic Center

Jean M. McQuillan, JD  
(Case Western Reserve University)  
Assistant Professor of Law

Maxwell J. Mehlman, JD  
(Yale University)  
Arthur E. Petersilge Professor of Law; Distinguished University Professor; Professor of Bioethics; Director of the Law-Medicine Center

Kathryn Sords Mercer, JD, PhD  
(Case Western Reserve University)  
Professor of Lawyering Skills

Dale A. Nance, JD  
(Stanford University)  
John Homer Kapp Professor of Law

Craig Allen Nard, JD, LLM & JSD  
(Capital University; Columbia University)  
Galen J. Roush Professor of Law; Director of the Spangenberg Center for Law, Technology and the Arts

Carmen Naso, JD  
(Cleveland State University)  
Senior Instructor of Law

Andrew S. Pollis, JD  
(Harvard University)  
Professor of Law

Cassandra Burke Robertson, JD  
(University of Texas)  
John Deaver Drinko - BakerHostetler Professor of Law; Director of Center for Professional Ethics

Matthew J. Rossman, JD  
(New York University)  
Professor of Law

Michael P. Scharf, JD  
(Duke University)  
Dean; Joseph C. Hostetler-BakerHostetler Professor of Law; Director of the Frederick K. Cox International Law Center

Barbara R. Snyder, JD  
(University of Chicago)  
University President and Professor of Law

Robert N. Strassfeld, JD  
(University of Virginia)  
Professor of Law

Jack Turner, JD  
(Case Western Reserve University)  
Assistant Professor of Law; Associate Director, Foreign Graduate Law Programs

Timothy J. Webster, JD, LLM  
(Cornell University)  
Assistant Professor of Law: Director of Asian Legal Studies

Lisa M. Wood, JD  
(George Washington University)  
Assistant Professor of Law

Ruqaiijah A. Yearby, JD, MPH  
(Georgetown University; Johns Hopkins University)  
David L. Brennan Professor of Law: Professor of Epidemiology and Biostatistics
Secondary Faculty

Shannon E. French, PhD
(Brown University)
Inamori Professor of Ethics; Professor of Philosophy; Professor of Law;
Director of the Inamori International Center for Ethics and Excellence

Brian K. Gran, JD, PhD
(Indiana University; Northwestern University)
Associate Professor of Sociology and Law

Kenneth F. Ledford, JD (University of North Carolina), PhD (Johns Hopkins University)
Associate Professor of History and Law

Ted Steinberg, PhD
(Brandeis University)
Adeline Barry Davee Distinguished Professor of History and Professor of Law

Martha A. Woodmansee, PhD
(Stanford University)
Professor of English and Law

School of Law Courses

Courses

LAWS 1101. Contracts. 4 Units.
The formation of a contract; problems of offer and acceptance; consideration; the question of contract breach; damages and remedies for a breach. Required.

LAWS 1102. Criminal Law. 3 Units.
A basic course in substantive criminal law, dealing with the standards to be used in defining and punishing criminal behavior. The course includes discussion of crimes and criminality; culpable mental states; causation; insanity; attempt and complicity; homicide; and rape. Required.

LAWS 1103. Torts. 4 Units.
This course covers compensation of an injured party for harm resulting from intentional or unintentional acts and omissions of others. Consideration is given to the rules, rationale, and policy underlying tort liability. The course includes analysis of assault and battery, false imprisonment, negligence, standard of care, duty, risk, causation, liabilities and rights of landowners and land users, liability relating to dangerous activities and defective products, liabilities arising from special relationships or specially recognized legal interests, and defenses. Required.

LAWS 1201. Civil Procedure. 4 Units.
A broad survey of the procedural development of a lawsuit is undertaken, tracing the various steps from pleading and discovery to trials and judgments. Modern procedural issues involved in jurisdiction of the courts, venue, choice of law, and former adjudications are discussed. Throughout the course principal attention is given to the Federal Rules of Civil Procedure. Required.

LAWS 1203. Property. 4 Units.
The nature of property interests; estates in land and future interests; concurrent ownership; landlord-tenant; transfer of property interests; easements, covenants, and equitable servitudes; nuisance; and zoning. Required.

LAWS 1204. Law, Legislation and Regulation. 3 Units.
Law, Legislation and Regulation is a required first-year course designed to introduce students to the structure of US government, the legislative process, principles of statutory interpretation, the operation of administrative agencies and regulatory process.

LAWS 1801. Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 1. 4 Units.
Students will study the fundamental lawyering skills of researching, analyzing, and writing about the law in LLEAP 1 (Fall semester of first year) and LLEAP 2 (Spring semester of first year). Skills include objective analysis and writing, complex factual and legal analysis and persuasive writing. In the simulation portion of the course students will begin to develop the basic skills of client counseling and oral advocacy.

LAWS 1802. Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 2. 4 Units.
Students will study the fundamental lawyering skills of researching, analyzing, and writing about the law in LLEAP 1 (Fall semester of first year) and LLEAP 2 (Spring semester of first year). Skills include objective analysis and writing, complex factual and legal analysis and persuasive writing. In the simulation portion of the course students will begin to develop the basic skills of client counseling and oral advocacy. The LLEAP 2 course particularly focuses on legal transactions. Students will learn the basic principles of reading, analyzing and drafting a contract, including identifying and developing substantive deal terms and contractual processes that should be added to the contract, although not identified by the client. By means of a simulated negotiation, the students will conduct a mock client interview and a business negotiation. Prereq: LAWS 1801.

LAWS 2001. Professional Responsibility. 3 Units.
This course deals with questions underlying the responsibilities of the lawyer, as a professional, to self, society, client, and the profession. Premises concerning the lawyer’s role or roles within the context of the adversary system are examined in some detail, as is the idea of professionalism. The Model Code of Professional Responsibility and the Model Rules of Professional Conduct are analyzed as generalized statements of the aspirations and obligations of lawyers, and as applied to concrete problems. Required.

The constitutional system of the United States; judicial function in constitutional cases; the division of powers between the nation and the states and within the national government; the powers of the president; national and state citizenship; and constitutional limitations on the powers of the states and nation for the protection of individual liberties. Required.

LAWS 2803. Legal Writing, Leadership, Experiential Learning, Advocacy, and Professionalism 3: Advanced Skills. 3 Units.
This course continues to develop the legal skills introduced in LLEAP 1 and 2 courses. Students will continue their study of legal research, analysis, and advocacy in this advanced writing course. Two sections will be offered each semester providing students with the choice of focusing on Litigation or Transactional work. Students will engage in simulated counseling with clients such as, negotiations, case management conferences, and firm meetings. In the Transactional section, students will work through an entire transaction starting with a letter of intent, continuing on to contract drafting and due diligence, and ending with the closing. In the Litigation section, students will be exposed to the entire spectrum of litigating a case, including pleadings, discovery, dispositive motions, pretrial filings, trial, and appeal. Prereq or Coreq: LAWS 4401
LAWS 3501. Criminology of Financial Integrity. 4 Units.
This course examines the basic criminology of predicate crimes to money laundering and terrorism financing from both theoretical and empirical perspectives. Following an overview of the basics of the study of criminology and research in the social sciences, the course reviews how these theoretical insights might apply to 5 predicate crimes: narcotics trafficking, corruption, human trafficking, and terrorism. Specific methodologies of laundering and terrorism financing will be reviewed and discussed.

LAWS 3502. Preventive Measures. 4 Units.
This course examines in detail measures that banks and other financial institutions are required to implement as financial integrity preventive measures. Focuses on risk assessment, customer on boarding and acceptance, record keeping, customer activity monitoring, suspicious activity report preparation, internal controls, and the supervisory process. Risk assessment techniques will be emphasized. Also, the course reviews the FATF preventive measures standards and methods of compliance assessments. A sampling of key national laws and regulations, including those of the United States, is included.

LAWS 3503. Operational & Law Enforcement. 4 Units.
This course will examine the operations of national financial intelligence units in analyzing suspicious activity reports and other data and information and in creating actionable intelligence from that information. It will then review the investigation and prosecution of both criminal and civil prosecution of financial integrity crimes. The course will also review the FATF operational and law enforcement standards and methods of compliance assessments. A sampling of key national laws and regulations, including those of the United States, will be included. Prereq: Must be enrolled in the Executive Master of Arts-Financial Integrity program.

LAWS 3504. International Cooperation in Civil and Criminal Matters. 4 Units.
This course will examine in detail how financial intelligence units, investigators, prosecutors, and investigative judges/magistrates cooperate with officials of other jurisdictions in identifying possible financial integrity crimes, investigating and prosecuting those cases, and recovering assets that are candidates for freezing or confiscation. The course will also review the FATF standards for cooperation in civil and criminal matters and methods of compliance assessments, relevant U.N. conventions, model laws and regulations, and a sampling of key national laws and regulations, including those of the United States. Prereq: Must be enrolled in the Executive Master of Arts-Financial Integrity program.

LAWS 3505. Building and Implementing an Effective Preventive Measures Compliance Program. 4 Units.
The course will examine specific problems that arise in building an effective preventive measures program. In addition to an in-depth examination of selected problems in designing and implementing preventive measures, the course will cover audits, inspections, on-site examinations, and sanctions. It will rely primarily on the presentation and discussion of case studies in each critical area of an effective compliance program, with a focus on the banking sector. Prereq: Must be enrolled in the Executive Master of Arts-Financial Integrity program.

LAWS 3506. Building and Prosecuting Criminal and Civil Financial Integrity Cases. 4 Units.
The course will examine specific problems that arise in building and prosecuting financial integrity cases. In addition to an in-depth examination of selected problems in building and prosecuting cases, we will cover problems in asset tracing and recovery, and will rely primarily on the presentation and discussion of case studies in each critical area of investigation and prosecution. Prereq: Must be enrolled in the Executive Master of Arts-Financial Integrity program.

LAWS 4101. International Law. 3 Units.
An introduction to basic comparative, transnational, and international law disciplines. Using areas of substantive and procedural law familiar to first-year students, the course examines issues arising from cross-national activity. Students are exposed to choice of law, comparative law, international law, and international institutions.

LAWS 4105. Fundamentals of International Law. 0 Unit.
Fundamentals of International Law is a special intensive format course which provides students undertaking a summer international law internship, who have not previously taken International Law in law school, an introduction to the rules of treaty interpretation, principles of customary international law formation, and some of the major institutions in the international system.

LAWS 4200. Bioethics and Law. 2 Units.
This course will explore how the legal and policy systems reconcile competing values and interests in controversies surrounding the practice of medicine. Case law, legislation, administrative law, and institutional policies will be examined, as well as selected commentary from the legal, medical, and philosophical perspectives. Substantive topics will include end-of-life issues, informed consent, use of new reproductive technologies, and other timely subjects in bioethics.

LAWS 4201. Health Law 1. 3 Units.
Health Law 1 and Health Law 2 are the core courses in the Health Law curriculum and both courses are required for the Health Law Concentration. The subject matter of the courses spans the entire field of health law, including (1) the history, structure, financing, and operation of the U.S. medical system; (2) legal and ethical rules and regulations governing physicians and other health care professionals; the patient-physician relationship; institutional providers of care such as hospitals, nursing homes, and laboratories; and drug and device manufacturers; (3) regulation of health insurers and managed care organization; (4) medical malpractice law; (5) confidentiality and electronic medical records; (6) fraud and abuse; (7) antitrust law; (8) employer health plans; (9) medical research; and (10) public health. The courses will be taught by a team of full-time and adjunct law professors and will include significant experiential exercises and opportunities. Grading will be based on periodic quizzes, memos, performance on experiential exercises, and final exams.
LAWS 4202. Health Law 2. 3 Units.
Health Law 2 is the second of two core courses in the Health Law curriculum. The subject matter of the courses spans the entire field of health law, including (1) the history, structure, financing, and operation of the U.S. medical system; (2) legal and ethical rules and regulations governing physicians and other health care professionals; the patient-physician relationship; institutional providers of care such as hospitals, nursing homes, and laboratories; and drug and device manufacturers; (3) regulation of health insurers and managed care organization; (4) medical malpractice law; (5) confidentiality and electronic medical records; (6) fraud and abuse; (7) antitrust law; (8) employer health plans; (9) medical research; and (10) public health. The courses will be taught by a team of full-time and adjunct law professors and will include significant experiential exercises and opportunities. Grading will be based on periodic quizzes, memos, performance on experiential exercises, and final exams. Prereq: LAWS 4201.

LAWS 4300. Intellectual Property Survey. 3 Units.
This course is designed to provide students with an overview of several areas of law traditionally associated with intellectual property or IP, including copyright law, which pertains to the protection of literary, musical, and artistic creations and has issues replete with First Amendment implications; patent law and trade secret law, which focus on the protection of technological works ranging from chemical formulae, to software, to biotechnology; and trademark law, which relates to the goodwill associated with corporate identity and product recognition. We will also devote time to the study of the philosophy and economics of intellectual property keeping in mind, throughout the course, the need to strike an optimal balance between incentives to create and commercialize intellectual creations on the one hand and public access to these creations on the other hand.

LAWS 4301. Copyright Law. 3 Units.
Copyright law is the in-depth study of the legal doctrine and policy relating to the protection of one's artistic, literary, musical, and computer-related expression. We will focus primarily on the 1976 Copyright Act and amendments thereto, such as the Digital Millennium Copyright Act of 1998.

LAWS 4302. Patent Law. 2 - 3 Units.
Basic concepts of patent law as property considered primarily in its substantive aspects, including the relationship to other forms of protection and intellectual property, infringement, and statutory requirements for patents.

LAWS 4303. Trademark Law. 3 Units.
Trademark Law is the study of how commercial entities use words and designs to identify the source their products and services in the minds of consumers and competitors. This course focuses on domestic and international trademark acquisition, retention, transfer, registration, and infringement. In addition to the common law of trademarks and unfair competition, much of this course will be devoted to studying the statutory scheme of federal trademark law.

LAWS 4311. Patent Preparation and Prosecution 1. 3 Units.
Patent preparation, drafting, and filing of a patent application are the fundamental aspects of patent practice. Students will learn how to conduct a client-inventor interview, what questions to ask the client-inventor and what information is most important to obtain prior to commencing the patent drafting process. Technical aspects of patentability searching will also be explored. In addition, the student will learn the various parts of the patent application and best practices associated with drafting each part. Before the drafting takes place, the class will cover relevant case law. Also, nonlegal, practical aspects such as organization, various grammatical concerns, and other concepts related to patent drafting will be covered. Ultimately, students will take the information provided in the class and draft an actual patent application based upon a simple hypothetical invention. Emphasis will be placed on specification drafting and claim drafting, and how to claim around prior art. Prereq or coreq: LAWS 4302.

LAWS 4312. Patent Preparation and Prosecution 2. 2 Units.
The course builds on Patent Preparation and Prosecution 1 (LAWS 4311) and will focus on aspects of patent prosecution post-filing. In particular, students will learn how to respond to an Office Action rejecting the patent application as is typically encountered during the practice before the US Patent and Trademark Office. The student’s response will take the form of an Amendment that will reflect changes made to the claims and arguments relating to patentability. The course will also cover the appeals process. Prereq: LAWS 4311.

LAWS 4315. Patent Agent Lab. 3 Units.
The patent claim is the most important part of the patent application, because it is the claim that represents the metes and bounds of inventor’s property right. This Lab is devoted to drafting claims, understanding the different types of claims, and how claims differ depending on the nature of the technology.

LAWS 4401. Business Associations. 4 Units.
This course is an introduction to the law of business associations, including general and limited partnerships, limited liability companies, and corporations. The functions and relationships of enterprise participants, primarily promoters, equity owners, creditors, and managers are investigated. The course covers pre-organizational problems and then canvasses the roles of ownership and management, with emphasis on the special duties (fiduciary and other) imposed on certain participants in publicly and closely-held entities. The regulation of securities fraud, proxy voting and solicitations, and the issuance of securities under the federal securities laws is explored. Fundamental concepts of business financing, including valuation of the concern and claim structure, are investigated. Organic changes, including dissolutions, mergers, and tender offers, are discussed.

LAWS 4402. Nonprofit Organizations Law. 2 Units.
Explores the rationales for the existence of the nonprofit sector and the allocation of certain functions to it. The focus is on the legal framework for the structure and operation of nonprofit organizations under state nonprofit corporation statutes and the policy and practice of preferred tax treatment for selected organizations and gifts to them under the Internal Revenue Code.
LAWS 4404. Sales. 3 Units.
One of the basic courses in commercial law. It serves equally as an introduction to the general organization, structure, and appropriate application of the Uniform Commercial Code. Primarily we study the law of Sale of Goods under Article 2 of the U.C.C. Necessarily this includes a study of products liability law, which is explored under both sales warranty and strict tort liability theories. The interrelationship between these competing theories of products liability law are also investigated. Other specific topics studied are the legal rules applicable to 1) the formation of sale contract, including the battle of the forms, statute of frauds, and parol evidence rule, 2) performance of and excuse of performance from the sales contract, 3) title warranties and title transfers, and 4) remedies for breach of the sales contract. Students may not take both LAWS 381 and LAWS 266 (Sales and Secured Financing).

LAWS 4405. Federal Income Tax. 3 - 4 Units.
An introductory course in federal income taxation of the individual taxpayer, including a consideration of the nature of income, specific statutory exclusions, business and nonbusiness deductions, the treatment of capital gains and losses, and elementary tax accounting.

LAWS 4406. Franchise Law. 1 Unit.
The course will provide an overview of federal and state regulation of franchise sales and will touch on other legal issues (types of business entities, trademark law) encountered when a business proposes to sell franchises. We will address sample franchise agreement clauses, requirements for completing the mandatory franchise disclosure document, and typical franchise related litigation scenarios.

LAWS 4704. Introduction to Legal Theory. 2 Units.
This course provides reflection on the most fundamental questions about the nature of law. The course is overtly philosophical, thus, the reading materials and discussion will include significant cases that both add to your knowledge of substantive legal doctrine and illustrate the theoretical ideas discussed. We will discuss laws and judicial decisions on topics ranging from jury nullification to punitive damages, from fugitive slave laws to sovereign immunity. But most importantly, we will discuss a variety of fundamental ideas that will be of real importance to you in the rest of your legal education and career. Time permitting, we will explore the distinctions between rules and standards, between rights and privileges, between property rules and liability rules, and between distributive and corrective justice. We will give considerable attention to the question of how courts should go about “interpreting” laws and to the considerations that are involved in advising a client who might be contemplating “gaming” the law.

LAWS 4705. Legal Methods: Privacy Torts. 2 Units.
This course examines the concept of privacy in the law, starting with Samuel Warren and Louis Brandeis's famous article, "The Right to Privacy" and moving through the how stated have adopted and implemented the tort rights that Warren and Brandeis identified in that article. The course will cover the historical bases for privacy torts and explore emerging issues such as how technological advances, like the internet and smart phones, have raised new challenges to the concept of privacy in tort law.

LAWS 4806. Administrative Law. 3 Units.
This course examines the legal and institutional framework within which agencies administer regulatory statutes, with emphasis on procedural and constitutional issues. Major themes include limiting arbitrary action, controlling agency discretion, and promoting governmental accountability. Examples and problems are drawn from a wide range of substantive areas, including business, communications, consumer protection, education, environmental, health and safety, intellectual property, labor and employment law, and real estate law.

LAWS 4807. Criminal Procedure I. 3 Units.
The investigatory stage of the criminal process. Constitutional limitations on searches and seizures, interrogation practices, and pretrial identification procedures are examined. In addition, the exclusionary rule, the principal method for enforcing Fourth, Fifth, and Sixth Amendment rights, is considered.

LAWS 4808. Evidence. 4 Units.
A comprehensive course in the law of evidence as applied in civil and criminal cases. Subjects include relevance, hearsay, judicial notice, privileges, examination of witnesses, expert and lay opinion testimony, and real, demonstrative, and scientific evidence. This course deals with both the practical applications and theoretical underpinnings of the Federal Rules of Evidence and common law precedents. Students may not take both LAWS 207 and LAWS 212.

LAWS 4809. Wills, Trusts, and Future Interests. 3 - 4 Units.
A survey of the law of intestate and testate succession, will substitutes, private and charitable trusts, fiduciary administration, and future interests (including the Rule Against Perpetuities).

LAWS 4810. Entering the Profession. 2 Units.
This course provides an introduction to the testing formats and required skills common to bar exams in United States jurisdictions, including the Multistate Bar Exam (MBE, multiple-choice format); the Multistate Performance Test (MPT, task-oriented essay); and essay questions in various substantive areas (which generally incorporate some state-specific content). Substantive content will be presented to provide raw material for practice testing. Students will earn the course credit by attending at least 80% of class sessions and completing 100% of written assignments with at least 65% success rate. Rewrites and retests will be allowed on request. The course does not comprise complete preparation for any bar exam. Rather, it provides familiarity, study strategies, and test-taking instruction along with limited substantive content.

LAWS 4820. Patent Bar Review. 4 Units.
Passing the patent bar is a requirement for practicing before the U.S. Patent & Trademark Office (USPTO). This course will introduce students to 35 U.S.C. (the United States "patent laws") and 37 C.F.R. (Code of Federal Regulations encompassing the patent rules), followed by an in-depth study of the M.P.E.P. (Manual of Patent Examining Procedure), which is the Patent Office's rule book that covers all the patent laws and rules as interpreted by the USPTO. In addition, the course will cover the particulars of the patent bar exam, including questions from prior exams; essential materials the students need to master to pass the exam, and provide students with several opportunities to hone their bar taking skills. Prereq: LAWS 4302 and LAWS 4311 and enrolled in the Master of Patent Practice program.

LAWS 4901. Foreign Graduate Seminar. 1 Unit.
This seminar is the required introductory course for foreign students enrolled in the Graduate Program in U.S. Legal Studies. It begins with a series of lectures introducing students to American legal education; American government, courts, and culture; various common law subjects; and professional responsibility. Throughout the year seminar sessions are held with legal practitioners from law firms and corporations in the Cleveland area who are involved in an international practice. Limited to the foreign LL.M. students.

LAWS 4903. U.S. Contract Law. 3 Units.
The subject matter and coverage of this course is approximately the same as the subject matter and coverage of first-year Contracts (LAWS 1101) as abbreviated and modified to reflect that it (a) is limited to foreign students who are candidates for the LL.M. in U.S. Legal Studies and (b) consists of 3 (not 5) credit hours.
LAWS 4904. Doing Business in the United States. 3 Units.
The course is designed to introduce foreign students to many areas of
U.S. domestic law through consideration of a transnational business
transaction. Examples of areas of law covered: restrictions on foreign
investment, regulatory agencies, banking and finance, importing and
exporting, business entities, litigation and alternative dispute resolution,
labor relations, immigration law, taxation. Limited to candidates for the
LL.M. in the U.S. Legal Studies.

LAWS 4906. Evidence. 3 Units.
This is a comprehensive course in the law of evidence as applied in
civil and criminal cases. Subjects include relevance, direct and cross-
questioning, impeachment, character, expert and lay opinion testimony,
and hearsay. A problem-oriented approach is used to highlight both the
practical applications and theoretical underpinnings of rules of evidence.
Students may not take both LAWS 4808 and LAWS 4906.

LAWS 4910. Language and Law. 0 Unit.
This course introduces students to the study of law in the U.S. and
provides students with a practical introduction to U.S. legal writing and
analysis. The class emphasizes reading, analysis, research, writing,
and comprehension skills necessary for students to participate in legal
discourse in a law school setting. The class allows international students
and professionals to develop language skills in a law-related context. No
credit is awarded toward the degree requirements, but completion of this
course may a condition of admission to the law school’s foreign graduate
programs.

LAWS 4911. SJD Seminar. 2 Units.
This year-long seminar is required of all SJD program students. The
purpose of the class is to improve the academic writing skills of SJD
students, introduce students to thesis writing, and to improve the English
writing skills of those students whose native language is not English.

LAWS 4912. U.S. Legal Research, Writing, and Analysis. 2 Units.
This is a required course for students in any of the Foreign Graduate
LL.M. programs. The course is designed to teach English compositional
skills and grammar for legal studies. With an English-as-a-second-
language focus, this course will seek to teach students the various steps
of the writing process, English grammar, and certain aspects of legal
composition. The main goal of this course is to enable students to write
clearly and correctly within U.S. legal studies and the U.S. legal work
place.

LAWS 4922. U.S. Legal Scholarly Writing. 1 Unit.
This is the second of a two-course sequence for students in the Foreign
Graduate LL.M. programs. This course focuses on advanced writing
schools, with special attention to legal research skills. The course is
required for students seeking a degree in the specialty LL.M. programs,
and is elective for other LL.M. students.

LAWS 4930. Intensive English Language Study. 0 Unit.
The course is designed for LL.M. students who have already studied
English and are below (but close to) the proficiency level for full-time
LL.M. studies. The course seeks student proficiency in spoken and
written English. The course provides intensive English speaking and
writing course designed specifically for foreign graduate legal studies
students needing English language skills to succeed in their legal studies.

LAWS 5110. Contemporary Issues in International and Comparative Law. 1 Unit.
The objectives of the course will revolve around initiating students to the
basic concepts and principles of comparative law reasoning and helping
students make sense of the increasing dialogue between jurisdictions
practicing constitutionalism in a global context with a focus on human
rights issues. The coverage of the proposed course will select from the
following themes depending on student interest and availability of
materials: (a) Freedom of religion, secularism and culture; (b) Freedom of
expression and hate propaganda; (c) Freedom of expression and sexual
representation; (d) Equality and same sex unions; (e) Assisted suicide;
(f) Death penalty; (g) Implementation of human rights in federal or quasi-
federal politics; (h) Socio-economic rights; and/or (i) Cultural rights.

LAWS 5111. Admiralty Law. 2 Units.
The general principles of admiralty law including jurisdiction, practice,
maritime liens, collisions, salvage, limitation of liability, and the rights of
injured maritime workers.

LAWS 5112. Canada-United States Law Institute Seminar. 2 Units.
Canada-United States Law Institute provides students with a broad examination
of the issues confronting the Canada-US relationship. Topics
discussed include comparative constitutional law, North American
trade & investment law, immigration, Canada-US border security, and
environmental issues – including the Great Lakes. The course includes
lectures by practitioners and government officials. Students are required
to author a paper that may be published in Canada-US Law Institute
material and journals.

LAWS 5113. Counterterrorism Law. 3 Units.
This course will take an in-depth look at counter-terrorism in the United
States, Israel, and other countries. The course will examine the competing
conceptions and definitions of terrorism at the national and international
level and the institutions and processes designed to execute the "war on
terrorism." This will include study of the balance between security and
liberty policies in the U.S. Patriot Act, the use of military tribunals or civil
courts, the use of assassination or targeted killings, and the emerging law
on enemy combatants and their detention, and the arguable need for new
self-defense doctrines at the global level.

LAWS 5114. European Union Law. 2 - 3 Units.
After a brief introduction to the institutions and organs of the European
Community, the legal aspects of the internal operations of the Community
will be discussed. Special emphasis will be placed on the external
impact of Community law, for example, its trading rules, company law,
and business competition law, as well as its rules governing the free
movement of goods, services, capital, and persons. The concept of
European citizenship will also be dealt with.

LAWS 5115. International Arbitration. 2 Units.
An advanced course covering the current status of arbitration as a dispute settlement mechanism in international affairs. This
course will cover the use of arbitration as a means of resolving international disputes: a) between private parties; b) between private
and governmental parties; and c) between governments. It will cover
possible forums and rules of arbitral dispute resolution and the problems
of the enforcement of foreign arbitral awards. Special aspects of
dispute resolution in certain geographical and subject areas will be
covered as will be the problem of sovereign immunity. Disputes arising
from multinational business transactions will be focused on as will be
maritime, environmental, and border disputes.
LAWS 5116. International Human Rights. 3 Units. This course will cover a variety of issues in the area of international human rights. Issues covered will include the law of treaties and treaty interpretation; international organizations’ and non-governmental organizations’ roles in protecting human rights; the rights of women and minorities; critiques of the idea of “universal” human rights; and the Alien Tort Claims Act. In addition to covering the procedure and substance of the international system for protection of human rights, we will also discuss human rights under various domestic legal systems from a comparative perspective. Grade is based on the final exam, class participation and possibly a group project.

LAWS 5118. International Law Research Lab. 3 Units. Students in this unusual course undertake legal research projects designed at the request of various international law enforcement organizations. Recent clients include the International Criminal Court, the UN-affiliated tribunals in Cambodia and Sierra Leone, Interpol, U.S. Military Commissions, and the U.S. Coast Guard, among others. Course sessions explore the development and practice of international criminal law as well as developing jurisprudence relevant to the current students’ projects. Substantial time is devoted to in-class discussion of target issues, writing workshops, and individual presentation of findings. Completed projects are forwarded to the requesting clients and posted in the school’s international war crimes portal. Grades are based on the quality of students’ participation and the final written product.

LAWS 5120. International Business Transactions. 3 Units. This course examines various types of international business activities from a transactional perspective. It focuses on international sales, international payments, and international licensing transactions and examines the different legal systems (state, federal, international) that may impact on these transactions. It also considers commercial aspects of the interpretation of cross-border contracts, dispute resolution concerning cross-border contracts, and the role of lawyers. Some basic issues relating to private international law/conflicts of law are also addressed. There is also some introductory coverage of international electronic commerce transactions and related legal issues.

LAWS 5121. International Criminal Law and Procedure. 3 Units. This course surveys selected issues and current problems involving the criminal aspects of international law and the international aspects of criminal law. The course begins with an introduction to the origins and purposes of international criminal law. We will then explore the contours of the duty to prosecute those who commit international crimes. Next, we will focus on application of domestic and international law to the question of jurisdiction over international criminal activities. This is followed by three units examining substantive international criminal law as contained in multilateral treaties concerning terrorism, war crimes and crimes against humanity. Next, we will explore the procedural aspects of international cooperation in criminal matters, with particular attention to extradition and problems associated with obtaining evidence from abroad. We will also analyze the reach of U.S. constitutional protections to U.S. investigative and law enforcement activities overseas. Finally, we will study the new Yugoslavia and Rwanda War Crimes Tribunals and the permanent International Criminal Court. The class will be seminar-format, with short writing assignments, weekly simulations, and role-play exercises designed to bring the materials to life. There will be no final exam.

LAWS 5122. Transnational Litigation. 2 Units. This seminar focuses on the litigation of transnational disputes in domestic courts. Topics include jurisdiction, international service of process procedures for obtaining evidence internationally, and the international enforcement of judgments. Students will complete a substantial research paper and will present the results of their research to the class.

LAWS 5123. International Trade Law and Policy. 3 Units. The public international and United States law regulating international trade. (The private law of international trade and investment is dealt with in International Business Transactions, LAWS 354.) It includes the economic theory of international trade (although no exposure to a course in economics in secondary or undergraduate education is necessary) as well as a legal examination of issues regulating global and regional (e.g., the Canada-U.S. Free Trade Agreement, EEC) international trade. Primary emphasis is on the General Agreement of Tariffs and Trade (GATT) and the World Trade Organization (WTO) as well as such United States legislation implementing the GATT as antidumping and countervailing duties legislation and escape clause relief. The roles of trade and aid are also explored, as well as U.S. legislation affecting the transfer of resources to less developed countries.

LAWS 5124. Islamic Law. 2 Units. This course will cover major aspects of the Islamic Law. It will provide students with a better understanding of Islam and its adherents. Many topics related to Islam and its basic beliefs, including some contemporary issues, will be covered in this course.

LAWS 5125. Jewish Law. 2 Units.

LAWS 5127. Race and American Law. 3 Units. This course provides students with both a broad survey of the history of race, racism, and American law, and an opportunity to focus individual research on a current issue through the lens, and in light, of the history. The course will focus on the historical, social and cultural context in which racisms originate and flourish; the role that law plays in both legitimating and overturning racisms; the role of courts and legislative bodies in addressing racisms; and other avenues of addressing racisms in light of law’s limitations and complicity in racisms. Areas of particular focus will include racial identity; equality, state violence; voting; education; incarceration; housing; hate speech; and remedies. Prereq: LAWS 2002 or equivalent.

LAWS 5135. War and Morality. 3 Units. The aim of this course is to explore a wide range of ethical issues relating to the decision to take a nation to war, how wars are conducted, and efforts to establish order in the wake of a conflict. Topics include the Just War tradition, pacifism, humanitarian intervention, moral repair and the establishment of a just peace, conduct of war, warrior codes, warrior transitions, and civil-military relations. We will be examining the ethics of war from the perspectives of both states and individuals. War is a crucible that strips those caught up in its horrors down to their fundamental selves inspiring acts of both inhuman depravity and seemingly superhuman nobility. This course is presented in a seminar format with lively discussions centering on contemporary readings in military ethics from texts and journals. Offered as PHIL 317, PHIL 417, and LAWS 5135.
LAWS 5136. International Humanitarian Law. 1 Unit.
This course is designed to prepare the student members of the Jean Pictet Competition team, but is open to all students with an interest in international humanitarian law. The course will be taught in two all-day Friday-Saturday sessions in January and February by international humanitarian law expert Gregory Noone, who is currently a fellow at the U.S. Institute of Peace and was previously Head of the Foreign Military Rights Affairs Branch of the Office of the Judge Advocate General at the Pentagon. Using case studies as well as simulations and role-playing exercises, the course will address the field of international humanitarian law as a whole, including the law of armed conflict, international criminal law, international human rights law, and the role of international organizations such as the ICRC and U.N. The objective of the course is to convey the reality of international law. Like humanitarian law itself, the course will not deal solely with legal disputes or judicial matters, but with practice and real life situations. The course grade will be based on a paper that will not satisfy the Writing Requirement.

LAWS 5137. Chinese Law. 3 Units.
This seminar will introduce students to the functions, purposes, and ongoing institutionalization of the law in the People’s Republic of China. After briefly examining China’s modern and traditional history, we examine the legal system’s role in the political, social and economic development of China. Over the semester, we will investigate several areas of law—constitutional law, criminal law, economic law, property and intellectual property—and then highlight topics of particular concern to the international community, such as human rights, the WTO and China’s commitment to international law. The goal is for students to understand both internal legal developments within China, the increasingly important role China plays on the global stage, and (ideally) to reflect upon the American legal system.

LAWS 5138. Chinese Business Law. 3 Units.
This course will introduce students to Chinese business law systems in the context of globalization and from the perspective of comparative law. We will examine the various legal aspects of “doing business in China” through discussing the Chinese corporate law, contract law, foreign direct investment law, and other relevant systems. Course objectives are for students to gain understanding of both the legal theories and practices in the field of Chinese business law, be able to identify and analyze the issues arising from the US businesses invested in China and/or the Chinese-US joint ventures, and be able to provide solutions to solve these issues.

LAWS 5172. Transnational Litigation Topics. 2 Units.
This course provides additional credits for students who are interested in doing additional research and writing in a specific area of transnational litigation. With the permission of the Instructor, this work may satisfy the JD Writing Requirement. Coreq: LAWS 5122.

LAWS 5173. International Trade and Dispute Settlement Topics. 2 Units.
This course offers students opportunities for advanced study and research in a selected area of International Trade and Dispute Settlement. Prereq or Coreq: LAWS 5123.

LAWS 5203. Food And Drug Law. 2 Units.
This course examines the federal Food, Drug and Cosmetic Act. It will entail a detailed look at the law, policy statements, and literature related to approving new drugs and devices. The course covers such topics as human subjects research; product labeling and testing; OTC vs. prescription status; compassionate use exceptions; control of biotechnology techniques; differences between food, drugs and devices; and FDA enforcement. We will also explore how law and the legal system anticipate and also respond to changes in technology in ways that may enhance or inhibit the development of new technologies and new applications of old technologies. Attendance at classes is mandatory. Grade is based on final exam.

LAWS 5204. Genetics and Law. 3 Units.
The current federal Human Genome Project is attempting to understand the health and behavioral implications of the 50,000 to 100,000 genes in the human body. Genetic tests are being offered to let people know if they are at risk of having a child with a genetic defect or if they will later in life suffer from cancer or other disease. Genetic predispositions are also being investigated for certain behaviors such as gay sexual preference, intelligence, and anti-social behavior. This course will cover the tort law, family law, constitutional law, criminal law, employment law, and insurance implications of developments in genetics.

LAWS 5205. Public Health Law. 2 Units.
This course surveys a range of issues in public health law including contagious diseases, health surveillance and privacy, tobacco, controlled substances, obesity, firearms, emergency preparedness and bioterrorism. It is designed to introduce students studying law or public health to the basic constitutional principles involved in public health law; the scope of local, state and federal authority to regulate; and the variety of ethical issues that arise.

LAWS 5212. Civil Law and Psychiatry. 2 Units.
The interaction between law and psychiatry in the rights of persons with mental disabilities in the community and in treatment settings. Topics include involuntary commitment, suicide, guardianship, psychiatric malpractice, psychic damages, special education, confidentiality and child abuse and custody. Students will test the analysis of legal issues against actual experience (videotaped interviews, visit to a state mental hospital). The course is jointly taught by a psychiatrist and an attorney specializing in mental health law.

LAWS 5213. Psychiatry & Law. 2 Units.
The interaction between law and psychiatry: psychiatric diagnosis and treatment, civil commitment, malpractice, right to suicide, competence to stand trial, the insanity defense, malingered mental illness, infanticide, violence, sexual predator laws, and direct and cross-examination of mental health experts. Videotaped examples serve as a basis for discussion. A visit to the Justice Center Court Psychiatric Clinic is included. The course is taught by a forensic psychiatrist.
LAWS 5215. Health Care and Human Rights. 3 Units.
This course combines two areas of law of increasing importance and public attention. In light of emerging medical, research, and genetic technology, courts, legislatures, administrative agencies and ordinary citizens around the world often face issues of health law. At the same time, in a world that is becoming both globalized and plagued by repeated instances of ethnic cleansing and other catastrophic abuses, issues of human rights are at the forefront of public debate. The intersection of health care and human rights, therefore, constitutes a worthy and fascinating area of study. Topics to be covered will be selected from among the following: 1) an overview of relevant human rights doctrines; 2) the concept of public health; 3) the status of the right to health care in different countries; 4) biomedical research involving human subjects; 5) genetic technologies; 6) disability rights; 7) women’s reproductive and health issues; 8) environmental abuses and human rights; 9) infectious disease, bioterrorism, and human rights; and 10) war crimes and other human rights abuses, as they impact public health.

LAWS 5219. Health Care Transactions. 2 Units.
This course will examine a variety of typical transactions among health care providers and payors. Students will have the opportunity to understand the financial motivation behind these transactions and to identify the unique health care law issues presented by them. Students will learn to develop alternative methods for structuring transactions to minimize or avoid such issues. The types of transactions to be examined include: physician recruitment, physician practice acquisitions, physician practice management companies, joint ventures between hospitals and physicians, mergers and acquisitions of health care providers, and formation of integrated delivery networks. Enrollment is limited to 25. Recommended preparation: LAWS 295. Prereq: LAWS 4201 and LAWS 5221.

LAWS 5220. Health Care Controversies. 2 Units.
In this experiential 2-credit course, students are confronted with a series of current, controversial, real-world problems in health law and policy, such as how to allocate transplant organs; how to ration expensive health care services; "reforming" the medical malpractice system; how the employment of physicians by hospitals alters the legal nature of the patient-physician relationship; legal issues associated with accountable care organizations under the Affordable Care Act; etc. To approximate real-world experience in the practice of health law, students are teamed with other students on a rotating basis and required to produce a team response and present it in class. For each problem, the student also is required to write a short memo (approximately 5 pages) describing their own personal solution or response. Six memos are due over the course of the semester, approximately one every two weeks. The students’ grade will be based on the grades they receive on the memos. Students from other health professional schools may enroll in the course and will be included in the teams. In addition to the law instructor there will be an outside medical or policy expert assisting with each problem. Prereq: LAWS 4201.

LAWS 5225. Research Ethics and Regulation. 1 - 2 Units.
This course is designed to introduce students to the ethical, policy, and legal issues raised by research involving human subjects. It is intended for law students, post-doctoral trainees in health-related disciplines and other students in relevant fields. Topics include (among others): regulation and monitoring of research; research in third-world nations; research with special populations; stem cell and genetic research; research to combat bioterrorism; scientific misconduct; conflicts of interest; commercialization and intellectual property; and the use of deception and placebos. Course will meet once per week for 2 hours throughout the semester. Grades will be given based on class participation and a series of group projects and individual short writing assignments. Offered as BETH 503, CRSP 603 and LAWS 5225.

LAWS 5226. Public Health Law Lab. 3 Units.
This Lab will involve students in an integrated experience of academic research and public service. Weekly sessions will provide a general background in public health law. Students will work on semester-long research projects for a State/Local Health Department or for the Network for Public Health Law, supervised by faculty at the School of Law. Topics may include environmental health regulations, emergency preparedness, cross-border public health, food safety, health information data sharing, injury prevention, maternal/child health, public health statutes and regulations, vaccination requirements, obesity prevention, and tobacco control. Grade will be based on collaborative work and written projects.

LAWS 5227. Legal Issues Affecting Hospital Medical Staff. 1 Unit.
This course will examine licensing and regulations of physicians, regulations affecting medical staff organization and governance, procedures that pertain to the appointment of physicians to medical staffs and their credentialing to undertake specific activities, the drafting of bylaws and rules and regulations that guide the performance and activities of physicians in hospitals, and procedures for undertaking corrective actions for physicians and for conducting fair hearings. Additional focus will be on processes for quality management including procedures for investigating sentinel events and for enhancing the patient experience. There will be an exploration of the relationship between physicians and hospitals including considerations for employing physicians or, alternatively, contracting with physicians and physician groups, particularly for hospital-based specialties. Prereq: LAWS 4201.
LAWS 5229. Information Privacy Law. 1 Unit.
Data is everywhere today, and being used by a broader range of entities for a broader range of purposes every day. Lawyers for virtually every industry (and around the world) must understand the key principles surrounding the use and disclosure of personal data when providing virtually all aspects of legal advice to their clients, including overall compliance, business strategy, mergers and acquisitions, litigation and the full range of specific privacy and data security laws and regulations. This law applies to the biggest companies in the world, as well as an incredible array of start-up and technology companies. This course will explore the primary legal and policy principles surrounding the use and disclosure of personal data, covering the key privacy and security laws, regulations and principles that govern how industry operates today in the United States and around the world. Day 1 will focus on general principles related to privacy and data security. We will explore the foundations of privacy law, focusing on Fair Information Privacy Principles. We will then proceed to the most recent history of privacy and security law in the United States, covering the key laws by industry sector (health care, financial services), specific practice (telemarketing, data from children), and the evolving law of data security. We will briefly review how these principles apply internationally as well. Then, we will explore emerging areas for privacy and information security, including new enforcement principles, application of these principles to vendor relationships, issues related to security breaches and notification and key litigation issues. Day 2 will focus on the health care industry and the specific laws, regulations and principles addressing the privacy and security of health care information. This day will emphasize the primary privacy and information security principles set out in the Health Insurance Portability and Accountability Act (“HIPAA”) as a baseline framework, and will explore how these rules apply in theory and in practice. We will also explore emerging areas for privacy and information security, including enforcement activities, other privacy and security laws impacting health care data beyond HIPAA, the law of health care research and related principles involving the "de-identification" of personal data, and the emergence of "non-HIPAA" data as a new challenge to the privacy and data security regulatory structure. Class sessions will consist of a combination of lecture, discussion, hypotheticals, and real-life problems drawn from the instructor’s experience in order to keep the class engaged. The goal for both days is to understand the key principles of the developing law in this area, but also to teach what a lawyer actually does on these issues and the need to combine legal knowledge with practical analysis and an understanding of business implications. We will also focus attention on critical policy issues related to this law, including a discussion of the emerging implications of "big data" principles on privacy rights and industry actions overall. Beyond learning the general principles of the law in this new and evolving area, we will focus on how to be an effective lawyer and provide useful advice to clients in this new and challenging area.

LAWS 5235. Health Care & Human Rights Topics. 2 Units.
This is a writing seminar that corresponds to LAWS 5215, for students who wish to do an in-depth research exploration on a topic covered in the Health Care & Human Rights course. Coreq: LAWS 5215.

LAWS 5268. Health Care Regulation Lab. 3 Units.
This course is for student interested in a more detailed exploration of Health Care Regulation topics. Work will include lectures, simulations, guest speakers, and research work. Prereq or Coreq: LAWS 4806.

LAWS 5313. Copyright and Trademark Litigation. 2 Units.
This course will begin with an overview of a copyright litigation case and then proceed to discuss issues relating to pre-litigation strategy, infringement, and defenses to infringement. Thereafter, the course will explore the drafting of a complaint and the answer thereto, including counterclaims; drafting discovery documents; preparing witnesses; and taking and defending a deposition, which will take place in the context of a mock trial, many of the issues that pertain to a trial, including the roles of judge and jury, jury instructions, direct and cross-examination, jury selection, and post-trial motions. Prereq: LAWS 4300 or LAWS 4301 or LAWS 4303.

LAWS 5314. Cyberlaw. 3 Units.
This subject deals with how the law regulates and otherwise applies to activities taking place in 'cyberspace.' It considers how existing legal principles are being modified and extended in the digital information age to meet the needs of society, particularly in relation to electronic commerce. As the nature of dealings in cyberspace develops and new legal problems emerge over time, the focus of the subject may change to reflect current legal issues. However, topics for discussion will be drawn from the following: the nature of the internet, legal regulation of cyberspace vs. self-regulation, the relevance of international law/international regulation, e-commerce contracting, 'property' in cyberspace with particular reference to intellectual property, trademarks and domain names, defamation on the Internet, online crime (e.g., fraud, pornography, etc.), information privacy and security, online dispute resolution and associated conflicts of law issues.

LAWS 5315. Entertainment Law. 1 - 3 Units.
This course is designed to introduce students to the basic legal issues relevant to the film and television industries, as well as live performances, theatre, and various other aspects of the entertainment industry.

LAWS 5318. Intellectual Property Licensing. 2 Units.
Students will explore how companies develop business and legal strategies to protect their intellectual property assets through agreements with strategic business partners, content providers, vendors, and licensees. As part of the course, students will select a company name and protect it, draft and negotiate agreements, and hold a mock negotiation at the end of the semester. One prior course in patent, trademark, or copyright is required. Grade is based on a final examination. Prereq: LAWS 4300 or LAWS 4301 or LAWS 4302 or LAWS 4303.

LAWS 5319. International Intellectual Property. 3 Units.
LAWS 5322. Intellectual Property & Dealmaking. 2 Units.
This course will provide you the opportunity to engage as an Intellectual Property (IP) specialist in a simulated M&A (merger and acquisition) corporate transaction. You will assume the role of an associate attorney in a law firm and handle certain aspects of the sale of assets of a business, including engaging in due diligence, reviewing and drafting documents, conducting research, analyzing negotiation techniques, learning about the specialist’s role in the transaction, and preparing for the closing of the transaction. Particular emphasis will be upon IP licensing (e.g., patent licenses, trademark licenses, etc.), such as reviewing and drafting IP licensing documents. You will learn skills that an IP lawyer should have by working on and resolving IP issues from actual projects. Accordingly, it is vital to your success in this course that you complete all assignments on time and actively participate in each class. Although this course is set within the context of a company acquisition, most of the IP issues you will be analyzing are generally applicable to many other projects that an IP associate will confront. Prereq: LAWS 4401 and (LAWS 4300 or LAWS 4302).
LAWS 5323. Intellectual Property Strategy. 1 Unit.
Intellectual property rights are legally created business assets used by companies to provide a competitive advantage in the marketplace. Companies use intellectual property differently depending on many factors, such as industry, business strategy, culture and maturity. Intellectual property attorneys are considered valuable members of business teams, contributing to business strategy, business planning and other executive level business decisions. Indeed, IP is a boardroom issue. This class will study the ways intellectual property is used by different companies and how the intellectual property laws impact not only the intellectual property assets, but also the business strategy and business planning. In addition to learning how intellectual property is being used by major corporations, universities, and entrepreneurs/start-ups, the students will pick one company and study how that company manages its intellectual property. Prereq: LAWS 4300 or LAWS 4302.

LAWS 5324. Law of the Music Industry. 2 Units.
This course will cover the major components of the music industry, including recording agreements (major label and independent labels), record producer deals, songwriting and music publishing concepts, group issues, personal appearances, and music in cyberspace. There will be an extensive discussion of fundamental copyright, trademark, and cyberlaw concepts, as well as advanced copyright concepts specifically related to the recording and publishing industry. Special attention will be paid to the topic of musical copyright infringement litigation. Course materials will include selected cases, forms of the above agreements, and selected handouts. Guest speakers will include a variety of industry professionals, including personal managers, recording artists, record company executives, and concert promoters. Students will be invited to participate in a variety of special events, including attending a music industry seminar at The Rock and Roll Hall of Fame sponsored by Cleveland’s volunteer Lawyers for the Arts and attending the annual Mountain Dew High School Rock-Off held at the Odeon. Prereq: LAWS 4301 or LAWS 4300.

LAWS 5325. Law of the Visual Arts. 2 - 3 Units.
This seminar is concerned with the relationship between the art world and the law. The art world is comprised of numerous players, such as artists, dealers, museums, auction houses, art critics, forgers, thieves, looters, and the American and various foreign governments. This course focuses on the law’s relationship with each of these entities and how these entities relate to one another in both a cultural and legal sense. In particular, this course will explore at least three of the following issues: theft and plunder of art (especially from 1933-45); the illicit international art trade; artists’ rights such as First Amendment rights, copyright, moral rights, and the resale right; and the role and practice of museums in the art world, including provenance studies, and the museum’s relationship with the artist and community. The first class (and some subsequent classes) will be held at the Cleveland Museum of Art. After a lecture by a museum curator, the students will be given a tour of the museum’s collection that will focus on works of art that have particular relevance to the intersection of law and art. Prereq: LAWS 4301.

LAWS 5328. Intellectual Property and First Amendment in the Arts. 3 Units.
Students in this course will explore the First Amendment’s protections for artistic and cultural expression and work directly on real-life issues for clients at the cutting edge of media and entertainment law. We will examine issues involving Hollywood studios, graffiti artists, virtual reality, reality television, art installations, electronic music, and journalism in still-evolving areas of law. We will discuss issues facing media and entertainment lawyers in practice, and survey the roles lawyers play in the creative process. Class members will work (under supervision) on client matters for the First Amendment and the Arts Project. Prereq: LAWS 4300, LAWS 4301, LAWS 4303 or LAWS 5717.

LAWS 5332. Sports Law. 3 Units.
Sports and Entertainment Law is the study of legal issues and problems relating to the music, television, and sports industries. This course focuses on the applicability of various legal doctrines to these industries, such as intellectual property law, labor law, and contract law. Also, emphasis will be placed on negotiation tactics and letter and contract drafting by conducting several negotiation and drafting exercises as well as a simulated representative relationship between the student and the entertainer/athlete. In the context of a mock litigation/arbitration, students will also be required to draft legal briefs in support of the contractual positions taken during the contract drafting exercises. Prereq: LAWS 4401 and LAWS 4405.

LAWS 5333. Representing the Professional Athlete. 2 - 3 Units.
This course will begin with an overview of the sports marketing industry and then proceed to discuss one of the more important legal doctrines relating to that industry, involving intellectual property, labor law, and contract law. In that context, the course will explore the skills necessary to conduct a series of sports-related contract negotiations. Students will participate in group-based contract drafting exercises, including drafting product endorsements and license agreements, with an emphasis on client representations. Next, in the context of mock litigation, students will assume a contract breach, and will be required to draft deposition questions and legal briefs in support of their respective contractual position.

LAWS 5334. Representing the Musical Artist. 2 - 3 Units.
This course focuses on practical training in counseling the musical artist with a particular focus on lawyering skills such as contract drafting, strategic thinking and negotiation. We follow the artist from the early days as a “baby band” to when the artist becomes “classic” or “heritage.” You will observe the artist in the recording studio, the interactions among the band members, the creation of songs/sound recordings. You will be introduced to the cast of characters: the producer; the first manager; the band members, the creation of songs/sound recordings. You will observe the artist in the recording studio, the interactions among the band members, the creation of songs/sound recordings. You will be introduced to the cast of characters: the producer; the first manager; the label’s A&R person; the recording engineer, and others. You will—as music lawyers commonly do—observe the artist creating in the studio and on a live stage and get a chance to speak with prominent managers, concert promoters, club owners, and artists.

LAWS 5335. Negotiation Strategies in Sports Management. 2 - 3 Units.
This course covers drafting of sophisticated contractual documents in the Sports Law world. Document that will be negotiated and drafted include a lease agreement between a municipality that is constructing a new stadium/arena and the owner/operator of a team that will play in the new venue. Also covered will be naming rights, presenting sponsorship agreements for beverage/food, automobile/rental cars, and financial/medical services. We will also examine coordination of all sponsorships in the team’s print/multimedia advertising, as well as with the broadcasts of the team’s games.
LAWS 5365. World Intellectual Property Organization Research Lab. 3 Units.
The course will explore cutting-edge issues directly at the interface between research and policy in international intellectual property at the World Intellectual Property Organization (WIPO). WIPO is the pre-eminent international institution responsible for the development, management, and coordination of international intellectual property. As it moves into its new 21st century mission and interaction with global policy issues such as public health, climate change, WIPO has a need for a stronger evidence and research base for its work on treaty development and technical assistance to countries. Students in the course will carry out cutting edge research on issues at the core of WIPO's work on the future of the international IP system. Working with the WIPO Traditional Knowledge, Genetic Resources and Folklore division, students will work in teams on specific research tasks with a finished written study or brief at the end of the course for internal WIPO use, and where appropriate, for broader dissemination. Projects may include carrying out country studies; comparative analyses of patent-related provisions in traditional knowledge laws; assessing implementation of international traditional knowledge, and folkloric obligations in domestic law; assessing the state of play in negotiations and processes in other forums such as the Convention in Biological Diversity, the TRIPS Council, or the Trans-Pacific Partnership negotiations. Prereq: LAWS 4101 or LAWS 4300 or LAWS 4301 or LAWS 4302.

LAWS 5366. Venture Finance & Transactions. 2 Units.
This course is designed to provide law students with the fundamentals of creating, offering and closing a technology venture transaction. In each case, the goal is to imbue students with both the legal and compliance requirements of the given strategic scenario, as well as the business and technical drivers behind the transaction. Prereq or Coreq: LAWS 4401.

LAWS 5369. Intellectual Property and Social Norms Advanced Research. 1 Unit.
This is a supplemental course for students enrolled in the IP & Social Norms who wish to do additional research to create a paper for fulfillment of the JD Writing Requirement. Students will work closely with the Instructor to define a research proposal and draft, refine, and complete a substantial research paper on a topic of mutual interest. Coreq: LAWS 5364.

LAWS 5401. International Tax. 3 Units.
This course examines the U.S. taxation of transactions undertaken by foreign individuals or entities in the U.S. as well as the U.S. taxation of transactions undertaken by U.S. individuals or entities abroad. Major topics that will be covered include determination of the source of income, the taxation of income derived from a U.S. trade or business, the withholding tax regime, taxation of various entities, controlled foreign corporations, the U.S. anti-deferral rules, the U.S. foreign tax credit, taxation of foreign currency transactions and the role of tax treaties. Prereq: LAWS 5403 or LAWS 5404.

LAWS 5402. Estate Planning. 3 Units.
This course covers the federal law of estate and gift taxation. Topics include the computation of the estate tax, the taxation of gifts, the assets included in the gross estate, deductions from the gross estate to compute the taxable estate, credits against the tax, the generation-skipping transfer tax, and estate planning ideas and techniques, such as the use of trusts. The income taxation of estates and trusts is also covered. Grade is based on class participation and a major written paper on a topic chosen by the student and approved in advance by the instructor. Prereq or Coreq: LAWS 4809.
LAWS 5403. Federal Taxation of Corporation and Partnerships. 3 Units.
The course will focus on the basic provisions of the federal income
taxation of partnerships and corporations. The topics will include the
formation of the entity, distributions to partners and shareholders,
the allocation of profits and losses in a partnership, S corporations,
redemptions, liquidations, mergers and acquisitions, corporate or
partnership divisions, and certain corporate penalty taxes such as the
accumulated earnings tax and the personal holding company tax.

LAWS 5412. Advanced Securities Regulation. 3 Units.
This course will expand on the disclosure and enforcement themes
discussed in the Securities Regulation (LAWS 307) survey course to
engage in an in-depth examination of selected real-world securities
topics. The focus will be to deepen the student's understanding of the
SEC regulatory regime through consideration of current "hot topics" in
securities law (such as executive compensation, 8-K disclosures, loss
contingencies and Management's Discussion & Analysis), by reviewing
SEC pronouncements and working with actual or hypothetical disclosure
and counseling situations. In addition to analyzing rules, students will
participate in drafting, analyzing and commenting on sample disclosure
documents and client advice memos. The course is designed to further
the student's understanding of a corporate/securities law practice as well
as deepen the student's substantive knowledge in securities regulation
law. Prereq: LAWS 5431.

LAWS 5413. Antitrust Law. 3 Units.
A study of the implementation of federal trade regulation statutes with
emphasis on the interrelationship of these laws with the competitive
tensions of the contemporary economy.

LAWS 5415. Bankruptcy. 3 Units.
An introduction to bankruptcy law, with emphasis on the current Federal
Bankruptcy Code. The course includes Chapter 7 (liquidation bankruptcy
proceedings), Chapter 11 (business reorganizations), and Chapter 13
(simplified reorganizations for individuals and sole proprietorships). Also
considered are various state law debtor-creditor remedies and the impact
of bankruptcy on such remedies. Prior enrollment in the UCC and debtor-
creditor courses may be helpful but is not mandatory.

This course is designed as an introductory course for second- and third-
year law students who want to understand the way in which businesses
are managed and financed, the various roles that capital markets play in
their development, and the methods for measuring business success.
Intensive case studies will be used as a framework for looking at real
world situations. The course will integrate guest lectures from visiting
business leaders. CFOs will explain how they measure the success of
their business and what financial information is required to do their
job. Finally, a part of each class will evaluate real time business issues,
applying the lessons learned from the case studies and modeling the
expected outcomes. James Bildner, CWRU alumnus and CEO of Tier
Technologies, will teach the course. Students will write a paper based on
a case study. This course will count toward the nine-credit limit on non-
law school courses. Prereq: LAWS 4401.

LAWS 5418. Corporate Real Estate Transactions. 2 Units.
Real estate is typically the largest single category of capital investment
and the second largest category of repeat expense (after total personnel
costs) for most businesses. Major industrial and service sector
companies are increasingly focused on the opportunities and challenges
inherent in the real estate portfolios that support their core operations.
This course will highlight the strategic case for effective corporate real
estate management and the role of inside and outside legal counsel in the
commercial real estate context. The course will consider advanced
transactional situations, including purchase and sale of commercial
properties, leasing of business properties, and complex industrial
facilities. The course's emphasis on case studies and commercial
transaction scenarios are also designed to act as a capstone course that complements and draws upon the students' prior coursework
in contracts, real estate and commercial transactions, ethics and
government regulation. Three parallel case studies will run throughout
the course, illustrating the application of each topic to different types of
client organizations: a Fortune 500 industrial company, a small family-
owned retail business, and a medium-sized not-for-profit organization
with several sites. Each client organization will have mock client
representatives who will have different business and style preferences,
which the class will need to accommodate and will come to anticipate in
fashioning and recommending solutions for each client. The final exam
will build from these same client scenarios, offering the class participants
an opportunity to apply their learning to make recommendations to each
client with respect to specific situations and goals.

LAWS 5419. Debtor-Creditor Law. 3 Units.
The creditor's power to enforce its judgments through such judicial
processes as attachment, execution, levy, garnishment, and creditors'
bills. The debtor's power to resist creditors' claims through statutory
exemptions or federal bankruptcy discharge, or because the creditor
has acted inappropriately or in bad faith. Also studied is the creditor's
power to set aside and avoid fraudulent transfers made by the debtor,
a power which has generated much litigation in recent years. We also
study the special rights of the federal government to enforce its claims,
through the Federal Debt Collection Act of 1990, the Federal Priority
Statute, and the Federal Tax Lien Statute. Finally, we survey collective
creditors' remedies under state law, including assignments for the benefit
of creditors, creditors' arrangements, and receiversons.

LAWS 5420. ERISA. 4 Units.
This class will cover employee benefits law. (ERISA): defined benefit
plans, including in-depth consideration of defined benefit plan
documents; VERA's, their use and regulation; group life, Accidental Death
& Dismemberment, and Long Term Disability plans and related insurance
documents; insured and non-insured medical benefit plans; reporting and
disclosure requirements of ERISA, including summary plan descriptions,
summary of material modifications, Form 5500, and "top hat" elections;
and requests for favorable determinations of qualified plans, including
Form 5300 and Notices to Interested Parties.

LAWS 5421. Financial Principles for Lawyers. 3 Units.
This course provides an introduction to the use of financial economics
that are frequently relevant in many areas of law. Topics to be covered
include the time value of money, uncertainty, claim structure (including
the characteristics of debt, equity, and hybrid securities, and the benefits
and detriments of debt and equity financing), behavior of securities
markets, and analysis of financial statements. Use of these concepts in
specific areas of legal practice will be discussed.
LAWS 5422. Financial Markets: Law, Theory, and Practice. 2 Units.
Explores the interactions of law, principles of finance, and the theoretical underpinnings of financial markets. It introduces students to the roots of evolving financial market liabilities affecting the interests and conduct of people at all levels in those markets by examining (a) the structure and purpose of financial markets, (b) the financial and capital market theories which today shape the contours of the law, (c) intermediation in financial markets, and (d) the challenges of global market regulation.

LAWS 5423. Financial System Integrity. 3 Units.
In this course, which is offered alternately as either a lab or a seminar, students study and research key aspects of the international financial system integrity rules, with a focus on the anti-money laundering and terrorism financing standards of the Financial Action Task Force (FATF) and the Basel Core Principles on Banking Supervision of the Basel Committee (as well as similar standards promulgated for other financial institutions). When offered as a lab, the course engages students in projects for a variety of organizations involved in improving the integrity of financial institutions, including the FATF (as well as FATF-style regional bodies), the International Monetary Fund, the World Bank, the United Nations Office on Drugs and Crime, and locally based governmental and non-governmental organizations. Students satisfactorily completing this course will be eligible to apply for a fully paid summer internship with a local bank that will involve work in the bank’s legal, anti-money laundering and financial intelligence units. Recommended preparation: LAWS 4405 and LAWS 5431.

LAWS 5424. Insurance. 3 Units.
A comprehensive introduction to the regulation of the insurance industry and to the legal issues arising from relations between the parties to insurance contracts. The course examines statutory regulation of the industry by state and federal agencies and analyzes cases involving aggressive regulation by the judiciary as well. Insurance decisions on the cutting edge of developments in contract, tort, and agency law are studied. Students are required to study the policy forms most frequently encountered in practice: the automobile policy, the homeowner’s policy, and the life insurance policy. The course also provides exposure to problems relating to other areas of insurance including commercial general liability coverage, fire insurance, professional liability (malpractice) coverage, and health insurance.

LAWS 5426. International Real Estate Transactions. 2 Units.
The course will explore selected topics involved in international real estate transactions, from the perspective of an American counsel representing an American entity doing business abroad. Topics may include structuring, transactional goals, due diligence, letters of intent and documentation, deal implementation, title protection, and others. The course will use traditional learning techniques as well as case studies and simulations, with a major focus on letters of intent/documentation. Students will be graded based on class participation and presentations, written assignments, and a final paper/take home exam. Recommended preparation: LAWS 5429 (may be taken concurrently).

LAWS 5427. Mergers and Acquisitions. 3 Units.
Topics include the corporate and securities law governing various forms of mergers and acquisitions; business motivations for mergers; concerns of acquiring and acquired companies in friendly mergers; bidders’ techniques and targets’ defenses in hostile tender offers and proxy contests; valuation of businesses and investments, portfolio theory, and capital markets; concerns of companies and investors in negotiating corporate financing. Prereq: LAWS 4401.

LAWS 5428. Products Liability. 2 Units.
Explores in depth the liability of manufacturers and sellers for physical injury to persons or property caused by defective products. The relevant law includes UCC warranty provisions, Restatement of Tort (Second) section 402A and other tort law, state “tort reform” statutes, and federal and state statutes regulating product safety, such as the FDA and the Consumer Product Safety Act. The course will also examine proposals to “reform” the law of products liability.

LAWS 5429. Real Estate Transactions and Finance. 2 - 3 Units.
Covers basic real estate transactions as well as issues involved in complex finance and development. Topics include: brokers, land contracts of sale, deeds and title covenants, the recording system, title insurance, mortgages, shopping center development, cooperatives and condominiums, ground lease financing, construction lending, distressed properties, selected federal income tax issues, and the real estate attorney’s professional responsibilities. Whenever possible, issues will be examined in the context of model transactions.

LAWS 5431. Securities Regulation. 3 Units.
This course explores the policies and techniques of state and federal investor protection, with emphasis on the distribution of securities by issuers and their affiliates. After an analysis of express general anti-fraud remedies, the “security” concept, and the diverse philosophies underlying “value judgment” and “disclosure” approaches to regulation of business fund-raising practices, the course proceeds to a full consideration of the impact of the Federal Securities Act of 1933 on primary and secondary distributions. Concurrent as well as independent effects of state blue sky laws, typified by the Uniform Securities Act, are also treated. To round out the total pattern of investor protection in the distributional setting, the course includes limited excursions into the anti-fraud, periodic reporting, public information availability, and broker-dealer aspects of the Securities Exchange Act of 1934. Prereq: LAWS 4401.

LAWS 5432. Business and Law Colloquium. 3 Units.
This course will bring together law students, business students, mid-level attorneys and senior leaders in the legal field for a one-semester weekly colloquium. Even though women have represented approximately half of law-school graduates for a number of years, women represent only 16% of law firm equity partners and even fewer corporate General Counsels. This course aims to offer an introduction to the business skills that both women and men will need to rise to the highest levels of law practice and organizational leadership. Each week will focus on a different aspect of law and business. The curriculum will include sessions focused in financial management, business development, communication skills, and intercultural business and law practices. Offered as LAWS 5432 and BLAW 411.

LAWS 5433. Payment Systems. 3 Units.
One of the basic courses in commercial law, dealing with the law of negotiable instruments and bank collections and deposits. These topics are considered primarily under the Uniform Commercial Code and, to some extent, recent federal banking and consumer credit legislation.

LAWS 5434. Secured Transactions. 3 Units.
This course deals with Article 9 of the UCC and other legal and equitable rules relating to the use of personal property as security for debts. Topics covered include creation of a security interest (mortgage), rights and obligations of the debtor (mortgagor) and the secured party (mortgagee), priority of interests in the same property, redemption rights of the debtor, and foreclosure of a security interest by the mortgagee. May not be taken by students who have taken or are taking the 4-credit Sales and Secured Transactions course (LAWS 5435). Students who have taken or are planning to take the 3-credit Sales (LAWS 4404) course may enroll.
LAWS 5436. Financial Institutions Regulation. 3 Units.

LAWS 5438. Business Organizations Research Seminar. 2 Units.
An opportunity to undertake significant research and writing on the law of business organizations. Each student will be expected to complete a major paper in satisfaction of the upper level writing requirement. A satisfactory paper will meet the writing requirement for the concentration in Business Organizations. Limited to 12. Prereq: LAWS 4401.

LAWS 5439. Corporate Finance. 3 Units.
This course provides both an introduction to important financial concepts and more centrally, an investigation of how those concepts come into play in the law (particularly corporate law). Topics covered will include: the capital asset pricing model, the efficient capital market hypothesis, the characteristics of debt and equity financing, options, and hedging. The course assumes no familiarity with these financial concepts, and while the math involved is critical, it will also be elementary. Throughout, the emphasis will be on gaining the ability to use concepts from finance in the context of legal problems. Prereq: LAWS 4401.

LAWS 5440. Communications Law. 3 Units.
This course provides a legal, technological, and policy introduction to modern communications regulation, including the regimes that govern broadcast, cable, wired and wireless telephony, satellite, and the Internet. Although there are no prerequisites for this course, prior study of the First Amendment, administrative law, antitrust law, and familiarity with communication technologies will be helpful.

LAWS 5442. Business and Law Advanced Research. 1 Unit.
This is a supplemental course for students enrolled in the Business and Law Colloquium course who wish to do additional research to create a paper for fulfillment of the JD Writing Requirement. Students will work closely with the Instructor to define a research proposal and draft, refine, and complete a substantial research paper on a topic of mutual interest. Coreq: LAWS 5432.

LAWS 5705. International Family Law. 3 Units.
This is a simulation course in advanced family law. Students will conduct the preparation, strategy, and execution of a civil family law hearing in selected areas, e.g., domestic violence. The student will study a major statute (e.g., Domestic Violence Statute, Ohio Code Section 3113.31), and simultaneously master the techniques of hearing, including opening statement, direct examination, cross-examination, closing argument, and learn the use of evidentiary objections and the handling of documents at trial. The choice of topic may change from year to year.

LAWS 5706. Advanced Legal Research. 3 Units.
This course will provide students with the practice-ready research skills needed when entering an externship, work setting or the practice of law. The focus will be on learning to research efficiently and cost-effectively with exposure to current technologies used in legal practice. The course will expose students to the skills needed in presenting thorough and reliable research to a supervisor or a court. The class will be formulated in a way that will allow students to spend much class time specifically working on research problems where they can get real time assistance.

LAWS 5707. Alternative Dispute Resolution. 3 Units.
Students will examine the processes of alternative dispute resolution (ADR) through reading materials, videotapes, guest lectures, and simulation exercises. Particular emphasis will be given to the interaction of lawyers and clients in business negotiations and in litigation. Negotiation, arbitration, mediation, and the mini-trial will be examined. The class will also cover impediments to ADR, such as lack of understanding or hostility on the part of clients or lawyers.

LAWS 5708. Electronic Discovery. 3 Units.
Electronic Discovery provides an in-depth treatment of the legal, technical, and cost management issues involving identification, preservation, collection, review, and production of electronically stored information ("ESI") in civil litigation. This course will cover how the federal rules of civil procedure, such as the 2006 FRCP ESI amendments: (Rules 26 meet and confer, 34 production, and 37 sanctions), and the Federal Rules of Evidence, such as FRE 502 (privilege review and production), along with the rapidly developing ESI case law affect this important aspect of litigation. The class will explore e-discovery software, providing training and exercise hypotheticals in which students will become familiar with the practical side of e-discovery.

LAWS 5709. Animal Law. 2 Units.
The goals of the course are to: a. Provide a clear understanding of the status of animal law as it currently exists, with an emphasis on recent statutes and caselaw; b. Explore how the law handles animals and animal-related issues in comparison with humans and other property; c. Provide a hands-on, practical experience for students who wish to grapple with cases involving animal law with either a moot court or special research project; d. Get students to think about and develop their own philosophy as it relates to animal law, and to test legal theories for advancing animal jurisprudence in the direction they deem appropriate.

LAWS 5711. Civil Rights. 3 Units.
This course will examine the enforcement of federal civil rights against the government, government officials, and private individuals. The course will focus partly on the unique issues and challenges involved in litigating civil rights cases, and approximately the first half of the semester will be spent on 42 U.S.C. § 1983, the "all-purpose" civil rights statute. We will discuss the mechanics of litigating federal civil rights cases, such as the state action requirement, absolute and qualified immunities, liability of municipalities, limitations on injunctive relief, and attorney's fees. Much of the second half of the semester will be devoted to other civil rights statutes, such as the Fair Housing Act, the Voting Rights Act, Title IX, and Title VI. The course will not cover statutes dealing with discrimination in the workplace, however, as those topics are treated fully in the Employment Discrimination course.

LAWS 5712. Community Development Law. 2 Units.
An examination of the law of economic and land development in underserved and deteriorated areas. Legal issues related to business organization, financing, real estate development, governmental programs, and regulation and taxation (among other areas) will be covered. Topics include background of urban deterioration, governmental and private sources of assistance, organizing the developing entity, financing the project, governmental programs, tax policy and programs, land assembly, and administration of developments.

LAWS 5714. Complex Litigation. 2 Units.
Analysis of key issues typically encountered in complex civil litigation including substantive implications of seemingly procedural choices. Class actions, multidistrict litigation, joinder and consolidation, exploration of practical and ethical issues encountered in complex civil litigation.

LAWS 5716. Conflict of Laws. 2 Units.
Competing approaches to choice of law in cases having multi-state and/or multi-national contacts. The course also covers personal jurisdiction, constitutional and international limitations on choice of law, and enforcement of judgments. Comparative and international perspectives are integrated throughout. Students develop their own choice of law theory in a simulated restatement conference.
LAWS 5717. Constitutional Law II. 3 Units.
This course explores the individual freedoms protected by the First Amendment. Primary attention is devoted to the freedoms of speech, assembly, and association. The course analyzes what is protected, why it is protected, and to what degree it is protected. Topics covered include prior restraint, advocacy of unlawful conduct, the hostile audience, defamation, commercial speech, obscenity, offensive speech, expression on public property, and symbolic speech.

LAWS 5718. Criminal Procedure II. 2 Units.
The adjudicatory stage of the criminal process. Pretrial release, preliminary hearings, grand jury practice, speedy and public trial, discovery, right to jury trial, guilty pleas, right to counsel, and double jeopardy are examined. Prereq: LAWS 4807.

LAWS 5720. Death Penalty Law and Process. 2 Units.
The course offers a review of the death penalty process, theory, and law from trial through execution, including examination of state laws and federal habeas corpus law. The course focuses on the legal principles implicated by the death penalty and also examines the social issues it raises including the social/legal arguments against the death penalty, race and gender issues, and the influence of political and other factors on the process. Recommended preparation: Evidence (LAWS 4808 or LAWS 4906).

LAWS 5721. Death Penalty Lab. 3 Units.
This Lab will involve students in an integrated experience of academic research and public service. Students will work on semester-long research projects arising from actual death penalty cases that will be of assistance to practitioners in death penalty cases or research projects for governmental and non-governmental organizations engaged in support for, opposition to, or reform of the death penalty at a local state, national, or global level. Issues may include: victim's rights; jury selection (race/gender discrimination); proportionality (discrepancies in geographic application or application to different fact patterns); economic impact on the system; clemency; and transnational problems with foreign accused; systemic review (e.g., Illinois commission); and other specific recurring issues arising from innocence, assistance of counsel, experts, jury instructions, or misconduct (judge, attorney, jury). The students will have no direct representation responsibilities.

LAWS 5722. Death Penalty Lab II. 2 Units.
This lab will involve students in an integrated experience of academic research and public service. As enrollment is limited to students who have successfully completed Lab I, these students will assume a supervisory role working with Lab I students. Students will work on research projects arising from actual death penalty cases that will be of assistance to practitioners in death penalty cases or research projects for governmental and non-governmental organizations engaged in support for, opposition to, or reform of the death penalty at a local state, national, or global level. Issues may include: jury selection issues; proportionality issues; economic impact of the application of the death penalty; examination of issues surrounding a specific state's ability to provide a viable clemency; issues of international law; research, investigation, and litigation of case specific issues ranging from actual innocence, ineffective assistance of counsel, ineffective assistance of experts, prosecutorial misconduct, judicial misconduct, juror misconduct, etc. Prereq: LAWS 5721.

LAWS 5723. Disability Law. 3 Units.
Disability Law provides a comprehensive overview of the federal laws relating to individuals with disabilities. The course focuses on issues of nondiscrimination and affirmative rights in the areas of employment, government programs and services, places of public accommodation and education. Beyond analyzing the legal framework that shapes disability rights, the course will also discuss issues related to disability rights from a social policy perspective.

LAWS 5724. Discrimination in Employment. 3 Units.
This course will examine the federal laws concerning discrimination in the workplace. These include Title VII of the 1964 Civil Rights Act, the Equal Pay Act, the Age Discrimination in Employment Act, the Americans with Disabilities Act, the Genetic Information Nondiscrimination Act. We will study the regulation of discrimination based on race, sex, religion, national origin, age, disability, and genetic status, including policy and ethical question and strategic considerations in prosecuting and defending employment-based civil rights actions.

LAWS 5725. Education Law. 3 Units.
This course surveys the legal and social policy challenges related to public education settings. Students will study relevant constitutional issues, legislative mandates, school vouchers to supplement tuitions in private schools, charter schools, and more recent attempts under state constitutions to provide a quality education for all children. Beyond analyzing the legal frameworks that shape public education, the course will also cover the difficulties confronting public education from a sociological perspective.

LAWS 5726. Employment Law. 3 Units.
This course examines employer-employee relations in non-union settings. Topics include wrongful discharge, occupational safety and health regulation, minimum wage, and workplace privacy issues. The course emphasizes written work, including advanced legal research training. Minimal overlap with Labor Law (LAWS 5737) and Discrimination in Employment (LAWS 5724).

LAWS 5727. Environmental Law. 3 Units.
The course is designed to provide an overview of both the breadth and depth of environmental regulation in the United States and to consider ways our environmental regulatory system might be improved. Although all of the major environmental laws will be surveyed, several statutes will be examined in greater detail. Students will be expected to navigate select provisions of statutes and regulations through in-class problem sets. Guest speakers will also be invited to speak on topics of current interest.

LAWS 5728. ePayment Systems. 1 Unit.
This seminar builds on the foundation established during the first-year curriculum and focuses on the law and technology of payment systems. Such topics will include the contractual relationship amongst and between the various organizations transacting to enable a b2c payment; the various elements of such agreements; the various impacts of a payment system (criminal, civil, and administrative); the implications for legal structure and policy; and the ethical considerations of a lawyer advising clients within this domain. Grade is based on a paper, a presentation, and class attendance and participation.
LAWS 5729. Expert Testimony in Civil Cases. 3 Units.
This course addresses the use of expert witnesses in civil trials, focusing on evidentiary issues. We will first examine several theoretical and conceptual issues concerning the role of experts as well as the pertinent standards of admissibility. We will give careful attention to what it means to make an argument from expert opinion. Then we will examine the use of expertise in a variety of contexts, including the proof of identity, proof of causation, proof of breach of duty, and proof of damages. Prereq: LAWS 1201 and LAWS 4808.

LAWS 5730. Family Law. 3 Units.
This survey course covers law relating to the creation, functioning, and dissolution of the family as a legal unit. Topics include legitimacy, adoption, procreative rights, cohabitation, marriage, family obligations, division of marital property, divorce and annulment, and child custody. Particular attention is given to the social forces that affect the development of rules and policies.

LAWS 5731. Federal Courts. 3 Units.
This course explores the relationships between the federal courts, Congress, and state courts and governments. Topics include congressional control of federal jurisdiction, justiciability, federal court abstention, suits against state and federal governments and officials, habeas corpus, and federal injunctions on state proceedings.

LAWS 5732. National Security and Procurement Law. 3 Units.
Government procurement law continues to interest policymakers, corporations, and legal employers in part because the total value of active federal contracts under administration exceeds several trillion dollars. This is a survey course covering many issues involved in the administration of federal contracts and procurement law, with a particular emphasis on the implications of procurement on national and international security interests.

LAWS 5733. Immigration Law. 2 Units.
The general principles of immigration law and procedure, including federal authority to regulate immigration, removal of aliens (deportation and exclusion), administrative and judicial review, fleeing persecution (refugees, asylees, and others), immigrant and nonimmigrant visas, and consular practice. The course will emphasize practical application of current immigration law.

LAWS 5734. Immigration Law II. 1 Unit.
The course is dedicated to the study of visas for visitors and aliens of extraordinary ability in the sciences, arts, or entertainment. Course materials will be drawn from Legomsky’s Immigration and Refugee Law and Policy, the Immigration and Nationality Act, and Title 8 (CFR). Students will be required to write a paper or prepare a visa petition. The course will likely be offered every other year. Prereq: LAWS 5733.

LAWS 5736. Juvenile Law. 2 Units.
The role of the juvenile court in society: its jurisdiction, procedures, and dispositional alternatives. Students study both the quasi-criminal aspects of the juvenile court (jurisdiction over juvenile delinquents and status offenders) and the civil-protective aspects of the court (termination of parental rights and the handling of neglected, dependent, and abused children). In addition, the rights afforded juveniles are compared with the rights afforded adults in comparable circumstances. Many related juvenile justice issues, such as the right of a minor female to have an abortion without parental notice and the constitutionality of capital punishment for juvenile offenders, are also examined.

LAWS 5737. Labor Law. 3 Units.
The basic course in the area of union-management relations, designed both for students desiring to pursue the field further and for those whose interest lies in an introduction to legal principles in this area. The course begins with a brief historical study of the evolution of the labor movement and prestatutory law. It then considers federal regulation under the National Labor Relations Act of union organizational efforts, management-union interaction, and the representational process, then proceeds to the collective bargaining process. The collective bargaining process is examined in some depth with special emphasis on the scope and substance of the duty to bargain in good faith, the enforcement of collective bargaining agreements in courts and by arbitrators, and the legal regulation of industrial warfare, the strike and lockout.

LAWS 5738. Land Use Control. 3 Units.
This course analyzes the public control of land use, primarily at the local and state levels. Both legal and policy perspectives are considered. Attention is given to constitutional limitations such as the takings doctrine, equal protection, and due process. Topics considered include zoning, subdivision controls, exclusionary regulations, and historic preservation.

LAWS 5739. Law of Archeological Relics. 2 Units.
This course addresses the private and public law relating to the ownership, sale, use, and repatriation of archeological artifacts other than human remains. The readings include excerpts from articles and books regarding the international trade (legal and illegal) in such artifacts. Significant attention is given to international law, such as the UNESCO Convention on Cultural Property.

LAWS 5740. Leadership and Communication Skills for Lawyers. 2 Units.
This 13-week interactive course will provide students with the tools and techniques needed to be more capable speakers and communicators. While the course will include some training for persuasive public speaking in a courtroom, most of the focus will be on developing effective communication skills so that students will have the requisite confidence, focus, and control to speak in a variety of settings. A section of the class will also concentrate on handling the media including how to control a message and advice for clients who may be in the public spotlight. The program will be interactive so that students have numerous opportunities to participate and speak. Role-playing exercises will be utilized as well as video-taped playback. Grading is based on participation and improvement and there will not be a final exam.

LAWS 5744. Mediation Representation: Theory, Principle and Practice. 3 Units.
An advanced course exploring the fundamentals of conflict, mediation theory, doctrine and practice, its historical evolution and increasing use as a centerpiece of modern legal dispute resolution. The course will cover the theory, doctrine, history and practice of mediation; the mediation process; the mediator’s, client’s, and advocate’s role in mediation; the underlying principles of bargaining, risk and value and how to adapt these negotiation skills for a mediation setting. Students will also learn how to use mediation as a problem-solver for the client. Format is lecture, discussion and student presentation and simulation. The course includes the writing of mediation memoranda, as well as mediation role playing, with critique from the teachers and invited guest mediation practitioners.
LAWS 5745. Foreign Affairs Law. 3 Units.
Provides a study of the separation of powers in national security matters, presidential war powers, congressional and presidential emergency powers, the domestic effect of international law, the use of military force in international relations, investigating national security threats, the Freedom of Information and Privacy Acts, access to national security information in the federal courts, and restraints on disclosing and publishing national security information. The course builds upon a strong foundation of constitutional law and addresses the fundamental tension that exists in our foreign and domestic affairs by virtue of the constitutional separation of powers between the respective branches of government. Several classroom hours will be spent dealing with constitutional war powers and how the executive and legislative branches have tried to define their respective measures of expressed and implied power with regard to the Vietnam War, the War Powers Resolution of 1973, and more recent US incursions such as the first Persian Gulf War and the most recent invasion of Iraq.

LAWS 5747. Philosophy of Law. 3 Units.
This is an examination of the general nature of law, the broad concerns of jurisprudence, the study of comparative law, and many of the issues raised in the literature of legal philosophy. Students will examine the principles of legal positivism, mitigated natural law, and rights theory. Selected readings and cases will illustrate these theories, which will also be examined in the context of rule selection by new governments in developing or revolutionary societies. The course also looks at the general nature of legal systems: how politics, morality, and individual views of justice and rights affect particular court cases and the course and development of law generally. Topics will include abortion, obscenity and sin, civil disobedience, affirmative action, surrogacy, and the death penalty. This is unlike any other of the legal theory or jurisprudence courses, and those who have sampled legal theory elsewhere in a different form are welcome and encouraged to enroll. Recommended preparation: PHIL 101. Offered as LAWS 5747, PHIL 335, and PHIL 435.

LAWS 5749. Prisoner Rights & Litigation. 3 Units.
This course explores the complex areas of habeas corpus and prisoner § 1983 litigation. The course explores the legal, procedural, social, economic and other issues surrounding federal court review of state court criminal convictions, conditions of confinement for prisoners, and prisoner rights. Topics will include standards of review, substantive rights, federal jurisdiction, and Constitutional reaches and limits.

LAWS 5751. Scientific Evidence in Criminal Litigation. 2 Units.
The legal issues associated with the use of scientific evidence at trial. It examines the admissibility of scientific evidence, expert testimony, and related issues. In addition, it considers specific techniques such as forensic pathology, fingerprint comparison, firearms identification, bite mark comparisons, questioned document examinations, and polygraph and DNA evidence testing. Outside experts are used to present many of the topics.

LAWS 5753. Child Welfare. 3 Units.
This course explores the underlying principles of child welfare. We will look at the state’s right to intervene where children are being abused or neglected; legal and psychological parameters of neglect; the parent’s right to raise children as they see fit, including the use of corporal punishment; the termination of parental rights; the role of an attorney GAL; legal representation of the agency and parents in child welfare hearings; and the liability of child welfare agencies. The format is lecture, discussion and student presentation, and simulation. The course includes a trial and concludes with a final paper and student presentations on topics of their choice. Prereq: LAWS 5730.

LAWS 5754. Energy Law. 2 - 3 Units.
Energy law is a large and growing area of increased importance. Energy use and production is subject to a wide range of state and federal laws. This course will focus on current energy law issues, particularly issues relating to production and use of electrical power. The course covers the interplay of state and federal regulation, utility rate regulation, energy production, and regulation of the environmental consequences of energy production and use, including climate change.

LAWS 5755. LGBT Legal Issues. 3 Units.
The course will address the development of legislation and case law dealing with LGBT rights in different practice areas including family law, estate planning, and employment law. Further, the course will deal with possible scenarios for future legislative and judicial activity.

LAWS 5760. The Wire and the War on Drugs. 3 Units.
Many currently criticize the American criminal justice system for being too severe and, in particular, having an unfairly harsh impact on African Americans. These complaints typically focus on the war on drugs and the way the American criminal justice system has prosecuted and punished drug offenses for the past several decades. This course uses the HBO series The Wire as a lens for understanding and evaluating the war on drugs. Students will examine: current drug offenses, the policy debate about legalization and decriminalization of drugs, conspiracy law, approaches to sentencing, the law of electronic surveillance, the fourth amendment, interrogation, the use of informants, the use of computerized statistical data to manage police departments, prisoner reentry programs and the influence of the media on criminal justice policy.

LAWS 5762. Urban Development Lab. 2 Units.
This course will involve students in an integrated experience of academic research and public service to the Greater Cleveland area. Students will work on semester long research projects arising from issues raised by local nonprofit development organizations and the development arms of other local nonprofit groups and government agencies. Specific topics will vary from semester to semester, but will generally fall within (i) barriers to development of urban properties, (ii) the role of local government and communities in encouraging or discouraging development projects and (iii) solutions for making urban areas, in general, and Cleveland, in particular, more livable and sustainable. When possible, students will present their findings directly to the organization(s) raising the issue. Students can expect direct or indirect exposure to aspects of real estate, finance, land use, tax and other regulatory law.

LAWS 5763. White Collar Crime: Prosecution and Defense. 2 Units.
This course will engage students in a study of issues relating to the prosecution and defense of white collar crime in America, e.g., defining/understanding "white collar crime," the role of the federal government in investigating and prosecuting white collar crime, corporate vs. individual responsibility, analyzing various white collar offenses: mail fraud and wire fraud, RICO, perjury/false statements/obstruction, securities fraud, and analysis of current white collar criminal prosecutions in the news (US v. Martha Stewart, the Adelphia prosecution, the Tyco prosecution, the Worldcom prosecution, the Traficant prosecution here in Cleveland), and exercises in prosecuting and defending white collar crime: investigations, charging decisions, and strategies in structuring a trial presentation and crafting jury addresses in complex white collar cases. As part of their final exam, students will be required to prepare and deliver a live jury summation (either for the government or the defense) in a mock white collar criminal case. Students will also sit for a short essay exam dealing with the various topics covered in class.
LAWS 5764. Workers' Compensation. 2 Units.
Workers’ Compensation law and theory continue to evolve through statutory change and judicial decisions. The statutes deal with benefits for work-connected injury and disability. Course material is national in scope with an emphasis on corresponding Ohio cases. The course also touches on related areas of law, such as torts.

LAWS 5766. Non-Capital Habeas Lab. 2 - 3 Units.
Students will be assigned to research, write, and litigate issues on live cases of both state and federal prisoners. As part of the course, students will learn how to properly and effectively represent clients in criminal cases through lecture, written assignments, oral advocacy and other skills-related activities. Prereq: LAWS 4808. Prereq or Coreq: LAWS 4807.

LAWS 5767. International Perspectives on Death Penalty. 3 Units.
The course will focus on the legal status of the death penalty as a matter of international law as well as the impact of international law on domestic use of death penalty with a focus on the United States. Topics to be explored include the role of the death penalty in international criminal justice, impact of domestic death penalty on international relations, foreign nationals on death row, mental illness and other status issues, and other procedural and substantive issues of retention and abolition.

LAWS 5768. Advanced Legal Writing. 3 Units.
This is an intensive course for students interested in taking the skills and lessons of the CaseArc courses and refining their written work product that it stands out in the community. The course is a rigorous mixture of lecture, in-class exercises, at-home assignments, and peer reviews.

LAWS 5772. Urban Development Topics. 1 Unit.
This course provide additional in-depth exploration and research opportunities in the area of Urban Development Law for students who have completed the Urban Development lab. Students and Instructor will mutually agree on specific topics to be explored in the course. Prereq: LAWS 5762.

LAWS 5902. Advanced Contracts. 3 Units.
We will examine the methodology of law and economics and of deontological approaches to contracts, legal realism, the methodology of default rules, gap filling and incomplete contracts, adjustment of long-terms contracts, employment contracts and the employment at will doctrine, promissory estoppel, relational contracts, incorporation strategies in the U.C.C. and the new formalism in Contracts.

LAWS 5903. Advanced Criminal Law Seminar. 3 Units.
This seminar focuses on substantive criminal law rather than criminal procedure. It uses the first-year criminal law course as a foundation and examines a number of issues not typically covered in that course. Student interests will influence the topics chosen for examination, which will include: theft offenses, conspiracy, fetal abuse, decriminalization of drug use and commercial sex, and the roles of the executive, judicial, and legislative branches in making criminal law. Grade is based on class participation, a presentation, and a research paper.

LAWS 5906. African-American Lawyers Seminar. 3 Units.
This seminar takes an interdisciplinary approach to the study of African-American lawyers. It examines aspects of the history of black lawyers in America, as well as topics relating to black lawyers in contemporary America. The course will situate these experiences in the context of both the history of the legal profession and the history of race relations and the struggle for civil rights in the United States. Students will prepare a substantial research paper and make an oral presentation of their research to the class. Limited to 12.

LAWS 5908. Constitutional Law Research Seminar. 2 Units.
This seminar permits students to write an in-depth paper, exploring an area of Constitutional Law most interesting to them. There are no explicit rules governing subject matter except that the paper must have, as its central focus, constitutional doctrine, policy, and/or analysis. Several classes will be held during the semester. The focus of these classes will be the process of writing a paper and the research tools available. A thesis statement, an outline, and at least one draft before the final paper are required. The grade will be based solely on the quality of the paper. The paper may be used to satisfy the writing requirement.

LAWS 5910. Environmental Law Research Seminar. 2 Units.
This course is for those students who wish to fulfill the writing requirement by writing on a contemporary environmental law subject.

LAWS 5912. Jurisprudence. 3 Units.
The seminar will explore classic jurisprudential questions using great works of literature as the vehicle through which the explorations will be made. The questions are: What is the nature of law? of justice? What is the nature of the obligation to obey or respect the law? Some of the texts which will be used include: "Antigone," "The Merchant of Venice," "Billy Budd," "Man for All Seasons," and "Judgment at Nuremberg."

LAWS 5915. Property Theory Seminar. 3 Units.
This seminar is designed to allow students to explore discrete areas of Property Law in the context of a developing theoretical framework for understanding concepts of property. The seminar will be built around the manuscript for my book called: Property Law and Social Morality. In that book, I develop a theory of property law that builds on a conception of the appropriate interaction between people with respect to resources (following the general outlines of the theory in my Tort Law and Social Morality). During the early weeks of the semester, students will read selected chapters from the draft of the book, as well as alternative theories drawn from law and economics, corrective justice, and rights-based literature. Students will then analyze a property law topic of their choosing in light of the theories presented in my book and our class discussions. A student might, for example, study the application of the theory to doctrines of Adverse Possession, shopping center development, and planned communities. Their analysis will either accept or refute the theory and will result in a publishable paper that they present to the class.

LAWS 5916. Religion Clauses of First Amendment Seminar. 3 Units.
This seminar will explore the constitutional doctrines relating to the Free Exercise Clause and the Establishment Clause of the First Amendment. The readings will include key Supreme Court cases demonstrating the evolution of free exercise and Establishment Clause doctrines, as well as some historical materials, but we will also maintain a focus on current First Amendment controversies, such as school vouchers, faith-based government funding initiatives, and religious symbols on public property. Grade is based on class participation, final presentation, and a paper. Limited to 12.

LAWS 5918. Reproductive Rights Lab. 3 Units.
In this course, students will complete research projects pertaining to cutting-edge issues in reproductive rights law. The lab will begin with an overview of the basics of the federal constitutional law pertaining to reproductive rights and related procedural issues. Students will then work individually on real-world research projects, such as drafting legal research memos, analyzing proposed legislation, and drafting litigation documents. Projects will be drawn from existing litigation, from bills proposed by state legislatures, and from national and Ohio-based reproductive rights organizations. Students will meet individually with the professor, supplemented by occasional group meetings. In the last class session, students will present their research projects to the group. Grades will be based primarily on the final written work product.
LAWS 5919. Scientific Evidence and Advanced Research. 2 Units.
Students must be concurrently enrolled in Scientific Evidence class (LAWS 5751). This course allows interested students to pursue additional research and writing within a particular focus area. With permission of the Instructor, the paper may be used to satisfy the JD Writing Requirement.

LAWS 5921. Social History of Crime Seminar. 3 Units.
This course is designed to offer students a somewhat different optic on the way that law operates in society, different, that is, from the sense one might get from reading case books. Here our concern is with the meaning of law in the largest sense, not so much from the standpoint of legal doctrine, but in the sense of how it works as a system of power to advance certain interests in society at the expense of less powerful groups. By "social history" I refer to the study of ordinary people, as opposed to political leaders and rulers. Thus the course explores how the law played out in the lives of ordinary men and women during the period from the eighteenth century to the present. What is a crime? How have certain customary rights been criminalized and why? What are the ideological underpinnings of the law? These are some of the questions we will take up as we examine crime in Britain and the U.S. from a thematic perspective.

LAWS 5925. Wrongful Convictions Seminar. 3 Units.
This course focuses on the causes of wrongful convictions, including eyewitness misidentifications, false confessions, jailhouse informants, scientific fraud, prosecutorial misconduct, and ineffective assistance of defense counsel. Remedies to prevent the conviction of the innocent are also discussed. A paper and presentation are required. Prereq or Coreq: LAWS 4808.

LAWS 5929. Judicial Selection. 3 Units.
This seminar will examine the present variety of judicial selection processes in the state courts of the United States through the lens of the ethical obligations defined in the Model Code of Judicial Conduct. Working from the Model Code, this seminar will focus on the various means used in states to select or elect judges and will examine the case law, challenges and controversies that have arisen from those methods. Do judicial election campaign contributions affect judicial independence and impartiality? In states which elect judges, can or should the right of free speech in a judicial campaign be limited or restricted? In states which do not elect judges, how to design or manage the selection process to ensure the appointment of an independent judiciary? This seminar will be graded based upon class participation and the submission of and presentation of a paper.

LAWS 5930. Human Trafficking Lab. 2 Units.
Students will examine and consider legal issues that arise in sex trafficking. Human trafficking is the second-largest crime in the world and is a $150 billion industry. Ohio has the fifth largest number of sex-trafficking victims and will serve as a backdrop for the course. Students will conduct research and craft solutions to issues raised by current gaps in legislation, victims’ issues, advocacy groups, and others. The subject matter will vary from semester to semester based on the issues the class is asked to investigate, but will frequently touch upon criminal, juvenile, human trafficking, municipal, housing, commercial, and other law. Students will participate in the representation of victims of human trafficking in both the adult and juvenile courts.

LAWS 5941. Environmental History and the Law. 3 Units.
This seminar is designed to introduce students to the relatively new and exciting field of environmental history and explain how it can help us better understand the law. Our concern in this course is not so much with black letter law, but with the larger ecological and historical context in which the law is formed. We will concern ourselves especially with the ways in which the law was used to transform the natural world, focusing exclusively on this story as it unfolded in the United States. Our goal is to see not just how law shaped nature, but also how the complexities of the natural world have affected legal doctrine. May satisfy the writing requirement.

LAWS 5962. Jurisprudence Topics. 1 Unit.
This course provides the opportunity for guided research study on topics of Jurisprudence, as a supplement to the topics explored in the Jurisprudence course, which must be taken simultaneously. Students will work with the Instructor to write a significant academic research paper, which may be used to satisfy the JD Writing requirement. Coreq: LAWS 5912.

LAWS 5980. Human Trafficking Advanced Research Seminar. 1 Unit.
This is an optional "add-on" credit for students participating in the Human Trafficking Lab course who wish to undertake additional advanced research in this topic area. With the permission of the Instructor, this course may be used to satisfy the JD Writing Requirement. Coreq: LAWS 5930.

LAWS 6001. Civil Litigation Clinic. 3 Units.
In this course, students handle various kinds of civil disputes on behalf of consumers who need legal assistance but cannot afford to pay for a private lawyer. Students are responsible for all phases of litigation, including the initial client interview and case assessment, preparation of pleadings and motions, conducting discovery, settlement negotiations, and, if necessary, trying the case before a judge or jury. A weekly two-hour seminar session provides a regular forum for learning the substantive law that applies to the students’ caseloads, as well as discussion of the various legal, professional, and ethical issues that arise in the cases. In addition, after completing required basic mediation training, students act as mediators in small claims and/or landlord-tenant cases in municipal court. Students must be enrolled in and complete both semesters to receive credit. Prereq or Coreq: LAWS 4808.

LAWS 6002. Civil Litigation Clinic. 3 Units.
Continuation of LAWS 6001. Both semesters must be completed before credit is given.

LAWS 6011. Community Development Clinic I. 3 Units.
This is a year-long course; students must complete both semesters of work to receive credit. Students represent business and non-profit entities in formation of their businesses and to obtain tax exemption for non-profit corporations. They act as general counsel helping their clients plan for future projects and activities and operate in compliance with law that regulates their activities. Students may also help to structure tax, real estate and corporate transactions for entities. Students may have the opportunity to work on simple intellectual property matters including trademark, tradename and copyright registrations, as well as website issues and nondisclosure agreements. This clinic is primarily transactional in nature and is designed to expose students to the special problems encountered in representing entities and in structuring transactions. Seminar sessions will be devoted to discussions of applicable law pertaining to specific cases students are working on and development of the skills necessary to represent individuals and entities in transactional matters. Students also will be exposed to the ethical problems associated with entity representation. Prereq or Coreq: LAWS 4401 or LAWS 4402.
LAWS 6012. Community Development Clinic II. 3 Units.
(See LAWS 6011.)

LAWS 6021. Criminal Justice Clinic I. 3 Units.
Students handle a limited number of misdemeanor cases in municipal courts throughout Cuyahoga County. The seminar sessions are devoted to discussions of cases being handled by the students and to ethical and strategic considerations of criminal law practice, trial tactics, and plea bargaining. Hypothetical case studies are also used to increase the breadth of the students’ exposure to the criminal justice system. Each student also handles some prosecution in local court. Prereq or Coreq: LAWS 4807 and LAWS 4808.

LAWS 6022. Criminal Justice Clinic II. 3 Units.
Continuation of LAWS 413. Both semesters must be completed before credit is given.

LAWS 6031. Health Law Clinic I. 3 Units.
Students represent clients in social security disability claims, adult guardianships, health insurance claims and disputes, access to health care, special education for disabled children, nursing home transfers and discharges, and other health and disability law-related issues. They investigate complaints in nursing home and represent clients in administrative and court proceedings. A major part of the student’s responsibilities is to analyze the problems and determine the best way of resolving them. Seminar sessions are primarily devoted to specific skills and to discussions of matters being handled by the students. The ethical and practical problems encountered in health law practice are emphasized, as well as legal theory. This is a year-long course; students must be enrolled in and complete both semesters of work to receive credit. Prereq: LAWS 4808 and (LAWS 4200 or LAWS 4201).

LAWS 6032. Health Law Clinic II. 3 Units.
Continuation of LAWS 6031. Both semesters must be completed before credit is given.

LAWS 6041. Intellectual Property Venture Clinic. 3 Units.
The IP Venture Clinic will provide students with the opportunity to represent start-up companies and entrepreneurs and focus on intellectual property protection, technology assessment, corporate formation, confidentiality agreements and trade secret protection, material transfer agreements, technology valuation, opportunity analysis, private securities offerings, and technology transactions. The clinic provides opportunities to work collaboratively with inventors, MBA students, licensing managers, outside counsel, and venture capitalists. Prereq: LAWS 4300 or LAWS 4302.

LAWS 6042. Intellectual Property Venture Clinic II. 4 - 12 Units.
The IP Venture Clinic will provide students with the opportunity to represent start-up companies and entrepreneurs and focus on intellectual property protection, technology assessment, corporate formation, confidentiality agreements and trade secret protection, material transfer agreements, technology valuation, opportunity analysis, private securities offerings, and technology transactions. The clinic provides opportunities to work collaboratively with inventors, MBA students, licensing managers, outside counsel, and venture capitalists. Prereq: LAWS 6041.

LAWS 6051. Civil Rights, Human Rights, and Immigration Clinic. 4 Units.
The Clinic offers students a semester-long opportunity to experience a diverse range of civil rights and human rights litigation and advocacy in both the domestic and international context. Students will work on cases and projects, often as co-counsel with other lawyers and organizations, addressing constitutional rights and international human rights violations both in the United States and abroad. Examples of litigation and advocacy may include: -Representing individuals in Sec. 1983 civil rights cases relating to police misconduct, employment discrimination, and other civil rights violations; -Representing non-citizens in the United States unlawfully stopped by local law enforcement for civil immigration violations; -Representing non-citizens in applications for relief from removal or deportation, asylum, withholding of removal, and protection under the Convention Against Torture; -Partnering with foreign non-governmental organizations in South Africa in the research, reporting, and litigation of HIV/AIDS-related discrimination matters; -Working with a national human rights organization on an anti-human trafficking campaign, including providing the legal analysis; -Developing the legal analysis and strategy for ensuring that international sports associations enforce anti-discrimination treaties as applied to the LGBT community; and -Authoring amicus briefs in U.S. and international courts on behalf of selected human rights groups on a range of issues. Prereq: LAWS 4808. Prereq or Coreq: LAWS 5215 or LAWS 5711.

LAWS 6052. Civil Rights, Human Rights, and Immigration Clinic II. 4 - 12 Units.
The Clinic is the second semester extension of LAWS 6051 for those students undertaking a year long capstone experience in the Civil and Human Rights clinic. Prereq: LAWS 6051.

LAWS 6101. Immigration Law Practicum I. 3 Units.
The immigration Practicum provides an opportunity for students of achieve practical immigration experience by working with real-life situations before the immigration Court and the USCIS. Students will work on pending matters that may include preparation of legal memoranda or briefs, applications for relief (such as asylum, cancellation of removal, protection under the Violence Against Women, protections of non-citizen victims of domestic violence), and evidentiary submissions for pending cases. Students are required to attend master (preliminary) and individual hearings, and a pro bono refugee clinic offered with the Catholic Charities or Legal Aid Society. This is a year-long course. Prereq: LAWS 5733.

LAWS 6102. Immigration Law Practicum II. 3 Units.
The immigration Practicum provides an opportunity for students of achieve practical immigration experience by working with real-life situations before the immigration Court and the USCIS. Students will work on pending matters that may include preparation of legal memoranda or briefs, applications for relief (such as asylum, cancellation of removal, protection under the Violence Against Women, protections of non-citizen victims of domestic violence), and evidentiary submissions for pending cases. Students are required to attend master (preliminary) and individual hearings, and a pro bono refugee clinic offered with the Catholic Charities or Legal Aid Society. This is a year-long course. Prereq: LAWS 5733 and LAWS 6101.

LAWS 6103. Basic Mediation Training. 1 Unit.
This course provides students with basic mediation training. After successful completion, students will be certified, allowing them to serve as volunteer mediators in forums where basic training is required.
LAWS 6106. Pretrial Practice: Medical Malpractice. 2 Units.
This advanced skills course is a specialized version of the Pretrial Practice (Civil) course. The focus is on the work of counsel for plaintiffs and defense counsel in medical malpractice cases including pleading, discovery, motion practice, and settlement negotiation. The course will emphasize the special problems confronted in medical malpractice cases such as obtaining and interpreting medical records and dealing with expert medical witnesses.

LAWS 6107. Pretrial Practice: Civil. 2 Units.
This course picks up where most first-year legal research and writing courses leave off. We will examine intensively, among other things, the various discovery devices (including depositions, interrogatories, document requests, and requests to admit), pretrial motion practice, litigation as a means of achieving the best possible negotiated result, and alternative dispute resolution mechanisms (including mediation and arbitration). In other words, we will study the things that litigators spend most of their time doing and thinking about: how lawyers go about gathering and preserving evidence, the everyday interactions they have with courts, and the reasons they do all these things even though they rarely expect to get all the way to trial. The course will include simulations and extensive drafting assignments.

LAWS 6108. Pretrial Practice: Criminal. 2 Units.
This course introduces students to the key activities lawyers undertake in a criminal case in advance of trial. This course examines the various steps leading up to trial, such as the preparation of an indictment, the drafting of discovery requests, motion practice related to discovery and the suppression of evidence, preparation and negotiation of plea agreements, and other motion practice related to the pre-trial phase. This course is designed to expose students to the pretrial phase in a criminal case from the perspective of both the prosecution and defense. Anticipated topics for discussion will include case investigation, the gathering of evidence, pretrial problems typically encountered in a criminal case, and the role sentencing guidelines can have in shaping plea negotiations and other pretrial negotiations. The course will include simulations, drafting assignments, opportunities for mock oral argument, and negotiating exercises. Limited to 12 students.

LAWS 6110. Trial Tactics. 4 Units.
An intensive course in trial tactics, techniques, and advocacy. The emphasis during the first half of the semester is on practice in the separate components of a trial: direct examination, objections, cross-examination, use of rehabilitative devices, examination of expert witnesses, jury selection, opening statements, closing argument, and pretrial preparation. During the second half of the semester each student acts as co-counsel in a full trial. Videotape recording is used for critiquing student performance throughout the semester. Students may not take both LAWS 6110 and LAWS 395 (Trial Practice). Prereq: LAWS 4808.

LAWS 6111. Appellate Practice. 2 Units.
This course is designed to teach students the rules and formalities of appellate practice and help students develop the skills necessary to write an effective appellate brief and present a persuasive oral argument. During the first semester students research and write an appellate brief and engage in short in-class oral arguments. During the second semester students receive instruction on the organization and presentation of longer oral arguments, engage in a practice oral round and receive an individualized critique of their performance. They complete the course by competing in the Dunmore Moot Court Tournament, which culminates in a final round oral argument before sitting judges in the spring. Prereq: LAWS 1801 and LAWS 1802.

LAWS 6113. Deposition Skills. 1 Unit.
Student will learn, through group lectures and simulations, how to prepare for, take, and defend a deposition in a civil litigation case. Students will attend lectures presented by experienced civil litigation attorneys. Students will then practice the skills discussed in the lectures by taking and defending depositions that will be critiques by the course instructor and other experienced civil litigation attorneys.

LAWS 6501. Canada - United States Law Journal. 0 Unit.
Students enrolled in this non-credit course will serve as writers and editors for the annually published Canada - U.S. Law Journal.

LAWS 6503. Health Matrix Seminar. 2 Units.
Students write their Health Matrix notes through the year-long Health Matrix Seminar. Students work closely with the instructor to develop their topics, outlines, several drafts, and final notes. The course will include multiple individual meetings with the professor, extensive feedback, and formal presentations of the papers. Students will develop their writing and oral presentation skills and will receive training concerning advanced legal research, plagiarism, and statutory interpretation. 2L associates also will have responsibilities for journal production work, such as verifying footnotes.

LAWS 6504. Law Review Seminar. 2 Units.
The seminar will provide training in writing, editorial skills, and advanced legal research for students writing notes for the Case Western Reserve Law Review. Topics to be covered include plagiarism, selecting a topic, web-based research, advanced Lexis and Westlaw research, advanced research training in selected substantive areas, and writing techniques. Satisfactory completion of the note will satisfy the upper-level writing requirement. Grade based on the quality of the note and class participation.

LAWS 6505. Law, Technology and Internet Journal. 0 - 3 Units.
The Journal of Law, Technology and the Internet Seminar offers students interested in technology and intellectual property the opportunity to write their notes through a year-long seminar. Students work closely with the instructor to develop their topics, thesis, outlines, and final note. Students will have numerous individual meetings with the professor and extensive feedback of the papers. Students will develop their writing skills, learn about plagiarizing, and will receive training concerning advanced legal research. 2L associates will be trained for journal production work such as verifying citations. The course will also include 3-4 whole group meetings through the quarter. Second year students will also be responsible for performing an in-depth evaluation of the article accepted through the peer-review process. 2L editors will ensure that submitted articles have not been preempted by any article already in print. Once an article has been approved by the Faculty Peer-Reviewers, 2L editors will be given portions of the article for which they are responsible for verifying all citations, and performing textual edits required to bring the article into compliance with Journal policies.
LAWS 6600. Supervised Research Seminar. 1 - 3 Units.
Second- and third-year students may earn graded credit for an individual research project of scholarly depth and scope, under the close supervision of a faculty member. Approval of the faculty supervisor is required before registration. No student may undertake more than two Supervised Research projects or earn more than a total of four hours of Supervised Research credit. No student may work on more than one Supervised Research project in one semester. May satisfy the writing requirement.

LAWS 6701. Legal Writing Fellows. 1 Unit.
CaseArc Honors Fellows serve for either one semester of the full year as teaching assistants in the CaseArc program. With training, guidance, and under the supervision of the CaseArc faculty, the Honors Fellows work closely in small groups or one-on-one with students on their writing projects, in-class exercises and preparation for simulations. In addition to meeting regularly with students, Honors Fellows may participate for simulations, judge oral arguments and assist with research training. Overall, the Honors Fellows serve as mentors to their assigned students to help them make the most of the CaseArc courses and the law school experience in general.

LAWS 6705. Curricular Training: Law Field Research. 0 Unit.
This course is intended exclusively for the foreign national J.D. or LL.M. law student who wishes to gain applied legal experience based on their intended career path with an organization that offers course credit for internship experience. These internships may be either paid or unpaid. This course will provide a means for the student to build required skills and bridge the gap between the classroom and real world application. The student is encouraged to explore and discover additional avenues to assist in the management and advancement of his/her career. Does not count toward J.D. credit.

LAWS 7035. International Tribunal Externship. 12 Units.
This program provides opportunity for students to participate in a semester long program with a tribunal program arranged through the Cox International Law Center.

LAWS 7045. Federal Judicial Externship. 4 Units.
Students in the spring of their first year are selected for summer externships with specific federal district and circuit judges. Meetings with the externship supervisor at CWRU will complement the eight weeks of externing in the judge's chamber.

LAWS 7080. Sports/Entertainment Law Externship. 3 Units.
This externship is offered to selected students who participate in the summer Great Lakes Sports and Entertainment Law Academy. This externship offers academic credit for placement with various high-profile sports and entertainment law institutions.

LAWS 7110. Public Sector Externship. 2 - 4 Units.
The externship program allows for an upper-level law student to be engaged in an experiential learning process by working alongside practitioners in a variety of legal settings. The students work is supervised by both an on-site coordinator, and a law school faculty member. All externship participation must be coordinated and approved in advance by the school's externship coordinator.

LAWS 7120. Private Sector Externship. 2 - 4 Units.
The externship program allows for an upper-level law student to be engaged in an experiential learning process by working alongside practitioners in a variety of legal settings. The students work is supervised by both an on-site coordinator, and a law school faculty member. All externship participation must be coordinated and approved in advance by the school's externship coordinator.

LAWS 7130. Non-profit Externship. 2 - 4 Units.
The externship program allows for an upper-level law student to be engaged in an experiential learning process by working alongside practitioners in a variety of legal settings. The students work is supervised by both an on-site coordinator, and a law school faculty member. All externship participation must be coordinated and approved in advance by the school's externship coordinator.

LAWS 7200C. Capstone Externship. 8 Units.
This is an experiential learning conducted in an off-campus site, with the student participating in a full-time, semester-long legal trainee experience. Specific experiences will vary depending on the site of the externship. Students are given extensive mentoring and supervision with an on-site supervisor and a CWRU faculty supervisor.

LAWS 7510. SJD Thesis. 1 - 10 Units.
Students in the SJD program will develop and write a substantial research paper as part of the requirements for conferred of the degree. The topic and scope of the paper will be developed jointly by the student and the student's program advisor. Students will meet periodically as a group with the Director of Foreign Graduate Studies to discuss their research and to present their research to each other and as part of a faculty workshop.

LAWS 7511. Thesis - Master of Arts in Financial Integrity. 2 Units.
Each student researches a problem she or he has encountered in her or his professional practice and prepares both a research paper and a final, 10 minute presentation that describe the problem and how it might be resolved. During the duration of the seminar each student will lead a series of discussions laying out progress in addressing the problem and seeking comments from other students. The final presentation will be held at the US Treasury Department before a panel of experts from the Office of the Comptroller of the Currency, the Financial Crimes Enforcement Network, the Justice Department, the International Monetary Fund, and the World Bank Prereq: Must be enrolled in the Executive Master of Arts-Financial Integrity program.
SCHOOL OF MEDICINE

The mission of the Case Western Reserve University School of Medicine (http://casemed.case.edu) is to advance the health of humankind through the four interrelated components of Education, Research, Clinical Care and Public Service.

The School of Medicine provides three programs leading to the MD degree: the School of Medicine program, known as the University program; the Cleveland Clinic Lerner College of Medicine at Case Western Reserve University, known as the College program, which first admitted students in 2004; and the Medical Scientist Training Program, or MSTP, the oldest existing MD-PhD program (since 1956) with NIH MSTP support since 1975. The School of Medicine also partners with the School of Graduate Studies to offer programs leading to PhD and MS degrees, as well as certificates in disciplines in the School of Medicine.

As a research institution, the School of Medicine has a tradition of national leadership. The School of Medicine consistently ranks in the top tier of the nation's medical schools for federal research funding from the National Institutes of Health, and is proud of its Clinical Translational Service Award in partnership with its affiliates. In addition, a 2015 Academic Medicine study ranked the School of Medicine in the top 15 schools based on the achievements of its graduates. Faculty and trainee research is routinely reported in the nation's top journals, leading to biomedical discoveries and improved health.

The School of Medicine engages the community in public service in many ways. The School of Medicine's commitment links researchers and medical students to the community. The school's faculty provide 90 percent of the indigent health care in Cuyahoga County and a majority of the care for indigent patients in Ohio. A major economic influence on the northern Ohio area, the School of Medicine and its affiliated hospitals are among the largest employers of personnel in the area and further stimulate the economy by providing concepts for technology transfer to the business sector. On the international level, the School of Medicine has a global health and diseases program focusing on AIDS, tuberculosis, malaria and other diseases that directly threaten world health.

The school is very proud of the contributions made by its educators and graduates but doesn’t rest on its laurels. The curriculum constantly responds to the latest findings in education and medicine and sets the pace for other schools with input from gifted and committed scholars.

At least eleven Nobel Prize holders have ties to the School of Medicine:

- John J.R. Macleod, MB, CHB, DPH, physiology professor at Case from 1903 to 1918, shared the 1923 Nobel Prize in Physiology or Medicine for the discovery of insulin. Dr. Macleod completed much of his groundwork on diabetes in Cleveland.
- Corneille J.F. Heymans, MD, who was a visiting scientist in the Department of Physiology in 1927 and 1928, received the Nobel Prize in Physiology or Medicine in 1938 for work on carotid sinus reflexes.
- Frederick C. Robbins, MD, shared the 1954 Nobel Prize in Physiology or Medicine for his work on the polio virus, which led to the development of polio vaccines. He received the award two years after joining the medical school. Dr. Robbins was active at the school until his death in 2003, at which time he held the titles of medical school dean emeritus, University Professor emeritus, and emeritus director of the Center for Adolescent Health.
- Earl W. Sutherland Jr., MD, who had been professor and director of pharmacology from 1953 to 1963, won the 1971 Nobel Prize in Physiology or Medicine for establishing the identity and importance of cyclic adenosine monophosphate (AMP) in the regulation of cell metabolism.
- Paul Berg, PhD, who earned his biochemistry degree at the university in 1952, received the 1980 Nobel Prize in Chemistry for pioneering research in recombinant DNA technology.
- H. Jack Geiger, MD, a 1958 alumnus of the medical school, is a founding member and past president of Physicians for Social Responsibility, which shared the 1985 Nobel Peace Prize as part of International Physicians for the Prevention of Nuclear War, and Physicians for Human Rights (PHR), which shared the 1997 Nobel Peace Prize as part of the International Campaign to Ban Landmines.
- George H. Hitchings, PhD, who had been a biochemistry instructor from 1939 to 1942, shared the 1988 Nobel Prize in Physiology or Medicine for research leading to the development of drugs to treat leukemia, organ transplant rejection, gout, the herpes virus and AIDS-related bacterial and pulmonary infections.
- Alfred G. Gilman, MD, PhD, a 1969 graduate of the medical school, shared the 1994 Nobel Prize for Physiology or Medicine for identifying the role of G proteins in cell communication.
- Ferid Murad, MD, PhD, a 1965 graduate of the medical school, shared the 1998 Nobel Prize in Physiology or Medicine for discoveries concerning nitric oxide as a signaling molecule in the cardiovascular system.
- Paul C. Lauterbur, PhD, a 1951 graduate of the engineering school and a visiting professor of radiology at Case in 1993, shared the 2003 Nobel Prize in Physiology or Medicine for pioneering work in the development of magnetic resonance imaging.
- Peter C. Agre, MD, who completed a fellowship in hematology at Case while a medical student at Johns Hopkins, shared the 2003 Nobel Prize in Chemistry for discoveries that have clarified how salts and water are transported out of and into the cells of the body, leading to a better understanding of many diseases of the kidneys, heart, muscles and nervous system.

Two other distinguished alumni have served as U.S. surgeon general: Jesse Steinfeld, MD, a 1949 graduate, was surgeon general from 1969 to 1973, and David Satcher, MD, PhD, who graduated in 1970 and was surgeon general from 1998 to 2002.

Dr. Satcher also served as director of the Centers for Disease Control and Prevention from 1993 to 1998, and another medical school graduate, Julie Gerberding, MD, MPH, followed in his footsteps, in 2002 becoming the first woman to be named CDC director.

History

Since its founding in 1843, the Case Western Reserve University School of Medicine has been an innovator in medical education and a leader in pioneering research. Beginning as the Medical Department of Western Reserve College (and popularly known then as the Cleveland Medical College), the school moved into its first permanent home, in downtown Cleveland, in 1846. In 1915, a 20-acre site was secured for a medical center in University Circle, the current home of Case Western Reserve University, its School of Medicine, and two of the school’s affiliated hospitals, University Hospitals of Cleveland and the Louis Stokes Cleveland Department of Veterans Affairs Medical Center. University Circle also is home to many of the country’s outstanding cultural and educational institutions.

The school was one of the first medical schools in the country to employ instructors devoted to full-time teaching and research. Six of the first
seven women to receive medical degrees from accredited American medical schools graduated from Western Reserve College (as it was called then) between 1850 and 1856.

Already a leading educational institution for more than a century, in 1952 the School of Medicine initiated the most advanced medical curriculum in the country, pioneering integrated education, a focus on organ systems and team teaching in the preclinical curriculum. This curriculum instituted a pass/fail grading system for the first two years of medical school to promote cooperation among students instead of competitiveness, introduced students to clinical work and patients almost as soon as they arrived on campus, and provided free, unscheduled time in an era when doing so seemed unthinkable. Many other medical schools followed suit, and these components remain at the core of the medical school’s curriculum today.

In 1924, the School of Medicine moved into the most modern and best-equipped preclinical science building in the country at that time. That building, donated by Cleveland industrialist Samuel Mather, remains an integral part of the medical school complex. It was named the Harland Goff Wood Building in 1993 in honor of the late chair and professor of biochemistry and former provost of the university.

In 1971, the Health Sciences Center was completed to house the university’s medical, dental and nursing schools, as well as the Health Center Library. In 1994, the health sciences complex was named for now-retired U.S. Congressman Louis Stokes. The proximity of these excellent research and educational centers to other prestigious university departments, including science, engineering and social sciences, stimulates uniquely creative interaction among researchers and educators.

Another giant leap in research capabilities came in the early 1990s, when the Richard F. Celeste Biomedical Research Building, named for the former Ohio governor, was opened. The $70 million building, attached to the Wood Building, added 154,000 square feet of research space and includes conference spaces, a lecture hall, public spaces and a cafeteria.

The School of Medicine was the first medical school to provide laptop computers to all its students. Today, students use their laptops to access the entire syllabus as well as numerous electronic resources deemed essential by faculty. Students have access to the WiFi network at the medical school and across campus. Technology is used to enhance, not replace, the faculty-student interaction that occurs in the classroom, the laboratory and small group discussions.

In 2002, the School of Medicine became only the third institution in history to receive the best review possible from the body that grants accreditation to U.S. and Canadian medical degree programs, the Liaison Committee on Medical Education. Also in 2002, the school built on its tradition of innovation in education when the university and the Cleveland Clinic entered into an agreement to form the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, with the first class matriculating in 2004.

Recent boosts in research capabilities came with the spring 2003 dedication of a new, eight-floor addition to the School of Medicine’s Wood Building, which added more than 40,000 square feet to the medical school, primarily for research laboratories. Also as part of the project, 30,000 square feet of existing laboratory space in the Wood Building was renovated. And in the fall of 2003, the School of Medicine and University Hospitals of Cleveland dedicated the new, eight-floor Iris S. and Bert L. Wolstein Research Building, adding 320,000 square feet of space for up to 700 researchers.

**Affiliated Hospitals**

**University Hospitals** (http://www.uhhospitals.org)

University Hospitals serves the needs of patients through an integrated network of hospitals, outpatient centers and primary care physicians. At the core of the health system is University Hospitals Cleveland Medical Center. University Hospitals Cleveland Medical Center is home to some of the most prestigious clinical centers of excellence in the nation and the world, including cancer, pediatrics, women’s health, orthopedics and spine, radiology and radiation oncology, neurosurgery and neuroscience, cardiology and cardiovascular surgery, organ transplantation and human genetics. Its main campus includes the internationally celebrated UH Rainbow Babies & Children’s Hospital, ranked among the top children’s hospitals in the nation; UH MacDonald Women’s Hospital, Ohio’s only hospital for women; and UH Seidman Cancer Center, part of the NCI-designated Case Comprehensive Cancer Center. Go here (http://www.uhhospitals.org) for more information.

**The Cleveland Clinic** (http://my.clevelandclinic.org/default.aspx)

In 2002, the university and Cleveland Clinic entered into a landmark agreement to form the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University, with the first students matriculating in 2004. The “College Program” is a program within the Case Western Reserve University School of Medicine. Cleveland Clinic serves as an outstanding teaching site for all medical students in the School of Medicine, in addition to being the site for pre-clerkship education in the College Program.

Cleveland Clinic was founded in 1921 by four Case Western Reserve faculty members, three of whom are counted among the alumni of the Case School of Medicine. Cleveland Clinic’s main campus, where much of the activity associated with the program occurs, is located on 180 acres near the Case Western Reserve campus.

Occupying 44 buildings on 167 acres, Cleveland Clinic main campus includes a hospital, an outpatient clinic, a children’s hospital, specific buildings for cancer, eye, heart and urologic care, a research institute with supporting labs and facilities, and an education institute. To better serve the Cleveland suburbs with quality healthcare, Cleveland Clinic operates 18 family health centers, three health and wellness centers, 10 regional hospitals and numerous urgent care and medical offices. State-of-the-art imaging services are available, and several locations contain pharmacies and outpatient surgery centers.

Cleveland Clinic also has locations in Florida, Nevada, Canada, Abu Dhabi and, beginning in 2020, London.

In 2016, Cleveland Clinic recorded more than 7.14 million outpatient visits and 220,000 hospital admissions. Among them were patients from all 50 states and 185 countries. More than 3,500 physicians and scientists, 11,800 nurses and nearly 2,000 residents and fellows provide high quality care for patients.

Cleveland Clinic is consistently named as one of the nation’s top hospitals by *U.S. News & World Report*, and its heart and heart surgery program has been ranked No. 1 by *U.S. News* since 1995. Learn more about Cleveland Clinic (http://www.clevelandclinic.org).
The MetroHealth System (http://metrohealth.org)
The MetroHealth System is one of the largest, most comprehensive health care providers in Northeast Ohio, caring for people in and around Greater Cleveland for more than 170 years. This academic health care system is committed to the communities it serves by saving lives, restoring health, promoting wellness, and providing outstanding, lifelong care that is accessible to all.

Affiliated with Case Western Reserve University School of Medicine since 1914, MetroHealth is a center for medical research and education, with all active staff physicians holding CWRU faculty appointments. More than 400 primary care and specialty care physicians practice within The MetroHealth System. At the core of the MetroHealth system, is the MetroHealth Medical Center. The system’s main health care provider, research facility and teaching hospital is also home to the region’s only Level 1 trauma and burn center. However, The MetroHealth System also serves Greater Cleveland with more than a dozen urban and suburban primary and specialty healthcare centers in Cleveland, Strongsville, Westlake, Lakewood, Pepper Pike and Beachwood.

MetroHealth has received many accolades for its high level of care and the innovation of its physicians. Surgeons at MetroHealth are pioneering new techniques in minimally-invasive surgery for faster recoveries, while its primary care physicians are developing cutting-edge ways to manage common and chronic diseases through the use of electronic medical records and a patient-centered medical home model called Partners in Care. Its maternal-fetal medicine specialists are successfully managing the riskiest of pregnancies and saving the tiniest of lives. In addition, MetroHealth is nationally recognized by the American Heart Association for cardiac and stroke care and the cancer center has earned outstanding achievement awards for the treatment of cancer patients. Every year, MetroHealth provides care to more than 28,000 inpatients and delivers approximately 3,000 newborns. More than 790,000 visits are recorded each year in the medical center’s outpatient centers, and patient visits to the emergency department exceed 99,000. To learn more about MetroHealth and its locations and services, go here (http://metrohealth.org).

The Louis Stokes Cleveland Department of Veterans Affairs Medical Center (http://www.cleveland.va.gov)
The Louis Stokes Cleveland Department of Veterans Affairs Medical Center (VAMC) is a major teaching hospital of the School of Medicine and is an important site for the education of medical students. The Cleveland VAMC also supports more than 100 residency and fellowship training positions in medicine, surgery, and psychiatry and their subspecialties. Most VAMC physicians hold faculty appointments within the School of Medicine. The affiliation is overseen by the Deans Committee, consisting of the dean, department chairpersons from the School of Medicine, and key VAMC officials.

The Cleveland VAMC is a part of the VA Healthcare System of Ohio, linking VA health care facilities in Ohio in an integrated service network. Inpatient care is provided at the Wade Park location and includes medicine, surgery, psychiatry, spinal cord injury, neurology and rehabilitation medicine as well as a nursing home and a domiciliary. Outpatient care is delivered in primary and specialty care clinics located at Wade Park, Akron, Canton, Cleveland, East Liverpool, Lorain, Mansfield, New Philadelphia, Painesville, Ravenna, Sandusky, Warren and Youngstown. The medical center serves more than 100,000 individual veterans annually through approximately 11,600 hospital admissions and 1,884,000 outpatient visits.

An active research program includes activities funded through the Department of Veterans Affairs and other governmental and private funding sources. Total funding of approximately $21.5 million annually (from all sources) supports more than 50 principal investigators in a broad range of research endeavors. For more information, go here (http://www.cleveland.va.gov).

Advanced Platform Technology Research Center of Excellence
216.791.3800 x6003
Ronald J. Triolo, PhD, Executive Director
Gilles Pinault, MD, Medical Director

The Advanced Platform Technology (APT) Center (https://www.aptcenter.research.va.gov) at the Louis Stokes Cleveland Veterans Affairs Medical Center (LSCVAMC) is one of 13 designated Centers in the Rehabilitation Research and Development Service. The APT Center focuses on serving veterans with sensorimotor dysfunction, cognitive impairment, or limb-loss using cutting edge technologies and rehabilitation techniques, translating them from proof of concept to viable clinical options. Advances in material science, microfabrication and microsystem design, neural engineering, mechanics, and communications are captured and integrated for applications in prosthetics/orthotics, neural interfacing, wireless health monitoring and maintenance and all forms of enabling and emerging technologies. The APT Center is able to provide or facilitate access to the following resources:

- Neural modeling and analysis of interface designs
- Polymer and bioactive material development
- Microelectromechanical (MEMS) systems design and fabrication
- 3-D and laser printing/prototyping, mechanical testing and dynamic simulation
- Pre-clinical in vitro and in vivo verification of device performance
- Circuit, sensor and software design and fabrication
- System validation and design control documentation
- Professional engineering support and project management
- Administrative support for intellectual property protection, regulatory affairs, and quality systems.

The APT Center was established in 2005 as a collaboration between the LSCVAMC and Case Western Reserve University (CWRU). Over 50 Engineers and Clinician Scientists at the LSCVAMC, CWRU, Cleveland Clinic, University Hospitals, Cleveland State University, Kent State University, University of Michigan, and Cornell University are affiliated with the APT Center and contribute to its mission.

Case Comprehensive Cancer Center
216.844.8797
http://cancer.case.edu
Stanton L. Gerson, MD, Director, Case Comprehensive Cancer Center

The Case Comprehensive Cancer Center (Case CCC) is one of only 41 National Cancer Institute-designated Comprehensive Cancer Centers in the country. The Case CCC integrates the cancer research activities of the
largest medical collaborative in Ohio, Case Western Reserve University (CWRU), University Hospitals Case Medical Center and Cleveland Clinic under a single leadership structure. Our researchers dedicate themselves to improving cancer outcomes through basic studies into signaling pathways giving rise to cancer and its genetic and epigenetic causes, pursuing novel therapeutic targets, and analyzing lifestyle interventions to prevent cancer and detect it earlier.

The Case CCC has over 360 collaborating scientists and physicians who have successfully competed for over $119 million in annual funding. These investigators are organized into eight interdisciplinary scientific programs and have access to 15 Scientific Core Facilities. A unified clinical research effort consisting of 12 multidisciplinary clinical disease teams develop and prioritize clinical trials among the partner institutions.

Located in Cleveland, Ohio, the Case CCC serves a population with higher than average cancer rates. Research programs extend to CWRU affiliates MetroHealth Medical Center (the region’s county hospital) and Louis Stokes Veterans Affairs Hospital and to 13 community medical centers operated by University Hospitals and Cleveland Clinic.

As a consortium cancer center, Case CCC has become a powerful example of the potential generated by complementary institutions coming together for the benefit of research and discovery, patient treatments and community impact. Through its partners, Cancer Center programs extend throughout Northeast Ohio to offer residents access to cancer care through participation in community outreach, cancer prevention, cancer survivorship initiatives and a robust clinical trials operational effort coordinated across academic medical centers and community sites.

**Case Cardiovascular Center**

216.368.3391

Mukesh K. Jain, MD, Director, Case Cardiovascular Research Institute

Daniel I. Simon, MD, Director, University Hospitals Harrington-McLaughlin Heart & Vascular Institute Director, Case Cardiovascular Center

The Case Cardiovascular Center (http://www.case.edu/cvri) was established in 2006 with the central mission to develop premier clinical, research, and education programs in heart and vascular disease. The structure of the Center includes clinical (University Hospitals Harrington-McLaughlin Heart & Vascular Institute—UH-HMHVI) and research (Case Cardiovascular Research Institute—CVRI) arms.

The UH-HMHVI (http://www.uhospitals.org/services/heart-and-vascular/institute) is a multi-disciplinary team of nearly 60 full-time faculty members dedicated to (a) the prevention, diagnosis, and treatment of heart and vascular disease to both local and regional patient populations in Northeast Ohio, (b) the education and training of medical students, residents and fellows, and (c) the development of breakthrough medical advancements and practices to deliver superior clinical outcomes. These clinical services range from primary to quaternary levels of expertise and are provided at all the health are facilities within the University Hospitals healthcare system. The clinical programs are organized into 11 program centers that comprise the Institute.

The research activities of the CCC are focused on the development of premier research programs that span the full spectrum of activities from basic bench-side research to translational research (“first-in-man”) and clinical trials. The CVRI is focused on basic and translational studies. The Research & Innovation Center (RIC) of the UH-HMHVI is dedicated to innovative clinical trials and applied technology. The major areas of research focus in the CVRI include cardiovascular biology, mechanisms of gene regulation, innate immunity & inflammation, and stem cell & regenerative medicine. Investigators in the CVRI have full access to two laboratories for in vivo research in small and large animals. The RIC oversees all clinical research activities within cardiovascular medicine and surgery and is supported by a lead administrator along with nurse coordinators and staff to facilitate patient enrollment as well as regulatory/grant activities. Active areas of clinical research include interventional cardiology, vascular medicine, heart failure, electrophysiology, preventive cardiology& rehabilitative medicine, and cardiovascular imaging.

**Case Center for Imaging Research (CCIR)**

216.844.8076

James Basilion, PhD, Director - CCIR

Chris Flask, PhD, Director - Imaging Research Core

The CCIR (http://case.edu/medicine/ccir) is a joint venture between Case Western Reserve University School of Medicine and University Hospitals Cleveland Medical Center. The CCIR, through its 50 faculty members and state-of-the-art clinical and preclinical imaging capabilities, promotes interdisciplinary and translational imaging research. As the imaging research program at CWRU continues to grow, we strive to make the CCIR imaging capabilities available to the broader research community. This overriding goal has led to a strong collaborative relationship between the CCIR imaging faculty and basic and clinical researchers in many disciplines.

Within the CCIR, the Imaging Research Core provides facilities for both preclinical and clinical imaging studies. The Imaging Research Core serves as a shared resource for CWRU’s Cystic Fibrosis Center, the Case Comprehensive Cancer Center, the Clinical and Translational Science Collaborative (CTSC), and the Cleveland Digestive Diseases Research Cores Center. The preclinical facility includes two high resolution MRI scanners, a microPET/CT scanner, an X-ray scanner, and three bioluminescence/fluorescence systems. Magnetic relaxometers are also available for high throughput screening of developmental MRI contrast agents. In addition, a novel cryoﬂuorescence imaging system provides high resolution, 3D optical imaging capabilities. The Core also provides support for quantitative analysis of all imaging data.

A human 3T MRI scanner is also available through the Core for clinical research studies. Other clinical imaging options are also available within the Department of Radiology. The creation of a new radiopharmaceutical facility within the CCIR, together with our existing cyclotron and radioisotope delivery system, now provide the capacity to conduct a variety of molecular PET imaging studies from preclinical animal studies all the way to routine clinical studies.

**The Center for AIDS Research**

216.368.0271

Jonathan Karn, PhD, Director

Michael Lederman, MD, Associate Director

Since its founding in 1994, the Case Western Reserve University/ University Hospitals Center for AIDS Research (CWRU CFAR (http://casemed.case.edu/cfar)) has been a center of excellence for both clinical and basic science AIDS research. Investigators participating in the CWRU CFAR draw on resources from the Case Western Reserve University School of Medicine, University Hospitals Cleveland Medical Center, MetroHealth Medical Center, the Cleveland Clinic Foundation and the Joint Clinical Research Center in Kampala Uganda. As one of only
19 CFARs nationally, the CFAR plays an important role in ensuring that cutting-edge AIDS research and well received community outreach is supported in our region of the country. Major strengths in the CWRU CFAR include international research, especially with respect to research in tuberculosis and HIV malignancy, microbiomes, pathogenetics, virology, clinical trials, and training, at the national and international levels. As the first CFAR to make a major investment in international research, we have been able to expand a highly productive and long-standing scientific relationship with Makerere University, Kampala.

The CWRU CFAR shares and supports the mission of the National CFAR program to support a multi-disciplinary environment that promotes basic, clinical, epidemiologic, behavioral, and translational research in the prevention, detection, and treatment of HIV infection and AIDS. The CWRU CFAR provides: Leadership and strategic planning that promotes and supports outstanding HIV/AIDS research at our participating institutions, a vibrant series of seminars and meetings regularly bringing leaders in HIV research to our campus, laboratory cores with expertise, state-of-the-art instrumentation and technologies; pilot grant awards and mentoring to develop junior faculty interested in HIV; educational and training efforts which encompass the whole range of contemporary HIV/AIDS research; community outreach programs, and the promotion of and participation in collaborative research efforts within the national CFAR network and in Uganda.

**Center for Antimicrobial Resistance and Epidemiology**

216.791.3800, ext. 4788

Louis Stokes Cleveland Department of Veterans Affairs Medical Center (VAMC)

Robert A. Bonomo (robert.bonomo@va.gov), MD Chief, Medical Service

As antibiotic resistance has become a national and global public-health problem, top academic centers are preparing to launch ambitious programs addressing research on the basic, translational and clinical aspects of antibiotic resistance. The CWRU-VLAMC Center for Antimicrobial Resistance and Epidemiology (Case VA CARES) aims to translate research findings into clinically useful tools for the diagnosis and treatment of patients infected with multidrug-resistant (MOR) Gram negative organisms and mycobacteria. The center’s long term goals are: 1) to continue and expand this dynamic research program directed at understanding the mechanistic bases of resistance in order to develop innovative clinical and therapeutic approaches to deal with MOR organisms; 2) to develop a strong clinical research program of translational medicine on antibiotic resistance; 3) to incorporate drug discovery, whole genomic sequencing and other rapid diagnostic technologies into the management of patients infected with MOR organisms and mycobacterial pathogens, including tracking of outbreaks and molecular epidemiology of these organisms; 4) to enhance educational activities of trainees in aspects related with antibiotic resistance; and 5) work with existing services available at the School of Medicine, University Hospitals, and the Clinical and Translational Science Collaborative to disseminate research and educational activities both nationally and internationally.

The Bio-Nano Center was established in 2017 with a central mission of revolutionizing medicine and biotechnology by facilitating communication and providing key resources to faculty to accelerate discovery and development of bio-nanotechnologies across the Case Western Reserve University School of Medicine and the Cleveland research community.

The Bio-Nano Center provides a platform for interdisciplinary collaboration, bringing together scientists, engineers and clinicians studying and developing bio-nanotechnologies in diverse disciplines and from across the CWRU campus and the Cleveland area and beyond. In a boundary-free setting of modern science and engineering, where diverse scientific fields merge and new ones are born, team science is an essential requirement to make new discoveries and breakthroughs. The Bio-Nano Center’s mission includes the training and education of tomorrow’s researchers in an interdisciplinary and collaborative environment, bridging nanosciences, biomedical engineering, polymer science and engineering, imaging research, cardiovascular medicine, cancer biology and oncology.

The Bio-Nano Center focuses on 4 research thrusts: 1) immunotherapy and vaccines, 2) Novel therapeutics and drug delivery, 3) Molecular contrast agents and imaging, and 4) Advanced Materials. (Bio-)Nanomaterials have unique properties and abilities to navigate interactions with cells and the circulatory system (blood and lymph); these nanoscale objects can be engineered and programmed to selectively interact with specific molecular targets, cells, and tissues – molecular zip codes of the body – to deliver payloads. Targeted to the immune system, these bio-nanotechnologies can mobilize antigen-specific humoral and cellular immune responses to eliminate and prevent onset of cancer, infection and chronic disease. Engineered to carry contrast agents and/or therapeutic molecules, bio-nanotechnologies open the door for molecular diagnosis, longitudinal imaging of disease progression or response to therapy, while enabling disease-targeted treatment strategies thus overcoming systemic toxicities. Lastly, bio-nanotechnologies enable the manufacture of novel materials for tissue engineering and regenerative medicine. Applications of bio-nanotechnology are not limited to human medicine, having possible impacts on such fields as veterinary medicine, pesticide delivery, agriculture, and beyond.

**The Center for Child Health and Policy at Rainbow Babies & Children’s Hospital**

216.844.6253

Ann Nevar, MPA, Manager

Established in 2007, the Center for Child Health and Policy at Rainbow (http://www.uhospitals.org/rainbow/for-clinicians/child-health-policy) focuses on major health policy issues that are central to the well-being of children and youth. The Center recognizes that health policy forms a framework for all health care delivery, and that health policy is therefore essential to improving children’s health. In this way, the Center focuses on the nexus between policy and practice of pediatric medicine.

The Center fills the need to amalgamate expertise in pediatric medicine and research with expertise in health policy. Operating as a think tank, the Center brings together experts in child health, health finance, law and policy to perform policy analyses, consultations, research, educational programming, and community outreach to advance child health through policy. Work is focused on several areas including: Maternal/Fetal/ Newborn Health; Chronic Illness; Quality; and Care Delivery Systems. The
Center is the only program devoted to child health policy in Cleveland and one of few nationwide.

To date, the Center has accrued many products and achievements including: Ohio Health Policy Researcher of the Year in 2006; Ohio Health Policy Researcher of the Year for Independent Research in 2009; programs designated Centers of Excellence; multiple white papers, reports, and peer-reviewed publications; grants and awards from the National Institutes of Health, The Centers for Disease Control and Prevention, the Ohio Department of Health, the Ohio Department of Job and Family Services, and numerous foundations; and invited/elected memberships in state and national policy committees.

Center for Clinical Investigation
216.368.3286
http://cci.case.edu/cci/index.php/Main_Page
James Spilsbury, PhD, Academic Development Core Director

The Center for Clinical Investigation (CCI) was founded in 2007 and is part of Case Western Reserve University School of Medicine's Division of General Medical Sciences. The CCI serves as the academic home of Cleveland's Clinical & Translational Science Collaborative, a partnership of 4 local institutions (Case Western Reserve University, the Cleveland Clinic Foundation, the MetroHealth System, and University Hospitals) and member of a national consortium of approximately 66 institutions funded by the National Institutes of Health to increase the efficiency and speed of clinical and translational research across the country.

The CCI's mission is to enhance clinical and translational research efforts across the Cleveland area by: (1) spurring advances in knowledge of risk factors, outcomes and treatment effectiveness in the population; (2) facilitating the transfer of scientific advances to the community; and (3) developing a new generation of clinical researchers equipped with the skills needed to efficiently design, implement and interpret novel studies that address important public health questions. To accomplish its mission, the CCI provides computer systems and applications support for basic science and clinical research activities and works closely with basic science and clinical investigators in the CWRU Schools of Medicine, Nursing, and Dental Medicine, as well as the University Hospitals Case Medical Center, Cleveland Clinic, and MetroHealth System. The CCI has supported hundreds of clinical research and epidemiology projects, including local and national multicenter, longitudinal studies. The CCI has two cores that provide research support to all investigators: the Academic Development Core and Statistical Sciences Core.

The Academic Development Core manages the newly created PhD Program in Clinical Translational Science, the Master's Degree Program in Clinical Research (Clinical Research Scholars Program - see "Clinical Research MS" tab above), and the Graduate Certificate Program in Clinical Research. The Academic Development Core also delivers seminars and short courses in clinical research and works to coordinate educational activities in interdisciplinary clinical research across the CTSC's institutional members. The programs target investigators and other key members of the research team, including data managers and study coordinators. Training efforts in research design, research data management, statistical sciences, statistical software, and scientific communication are emphasized.

The Statistical Sciences Core provides data management and statistical support on study design and data analysis. Members who provide data management consist of skilled data managers and programmers who consult and collaborate with investigators on data collection instrument development and coding, database development and administration, data cleaning and quality assurance, statistical programming, and dataset preparation. Members providing statistical support collaborate and consult with clinical investigators on proposal development, study design, study monitoring, and data analysis. The Statistical Sciences Core currently consists of 1 PhD biostatistician and 1 MS biostatistician. Statistical software packages that are supported by the CCI Statistical Sciences Core include SAS, SPSS, R/S-Plus, NCSS PASS and Minitab. In addition, the Statistical Science core serves as a gateway for connecting investigators with the broad expertise available through the biostatistics faculty in the Department of Population and Quantitative Health Sciences.

Center for Global Health and Diseases
216.368.6321
http://www.case.edu/orgs/cghd/
James W. Kazura, MD, Director

The Center for Global Health and Diseases links the numerous international health resources of the University, its affiliated institutions, and the northern Ohio community in transdisciplinary programs of research and education related to global health. The scope of the Center’s activities also includes education and service as these are related to molecular, clinical and population studies of human health and disease.

The Center is currently a national leader in National Institutes of Health-supported studies of the major infectious diseases of developing countries. Cutting-edge approaches are implemented in order to examine the molecular, genetic and immunologic basis of susceptibility to infectious diseases of public health significance - malaria, river blindness, lymphatic filariasis, schistosomiasis, HIV and other viral diseases such as Rift Valley fever. Clinical research in endemic countries is concerned with testing and implementing cost-effective public health interventions that are aimed at the control of malaria and Neglected Tropical Diseases (worm infections of children, elimination of lymphatic filariasis). The Center has ongoing research and educational collaborations with academic and governmental institutions in Papua New Guinea, Brazil, Kenya, Uganda, and several other countries in Sub-Saharan Africa. Educational programs sponsored by the Center include electives in international health, population biology, and genetics of infectious diseases (available to undergraduate, graduate and professional school students), a weekly World Health Interest Group (WHIG) seminar series, overseas rotations for graduate and professional school students, and training programs at the university and abroad for scholars from developing countries (with support from the Fogarty International Center at NIH).

A certificate in Global Health is available (see Certificates).

Center for Health Care Research & Policy
216.778.3902
Randall D. Cebul, MD, Director

The mission of the Center for Health Care Research & Policy (http://www.chrp.org) is to: 1) improve the health of the public by conducting research that improves access to health care, increases the quality and value of health care services, and informs health policy and practice; and 2) lead education and training programs that promote these goals. Formally established in 1994, the Center's mission is carried out by a cross-disciplinary faculty who both lead and collaborate with other scholars in Northeast Ohio and beyond. A core faculty of 17 is extended by affiliated Senior Scholars throughout the university, assisted by an able staff and over 30 grant-supported research associates. The Center's home at MetroHealth's Rammelkamp Research and Education Building is
an outstanding venue for collaborative research, mentoring of students and junior faculty, and cross-disciplinary seminars.

The Center's research and training focuses in programmatic areas that reflect national health care priorities as well as high impact problems in adults. Center Programs pertain to chronic conditions, especially stroke, obesity and diabetes, and kidney disease. Programs are supported by methods units, including biostatistics and evaluation, health care decision making, and health economics and health policy. Research using clinical informatics capitalizes on growing institutional capacities in electronic medical records (EMR) and clinical decision support. Center faculty view Northeast Ohio as a laboratory for research, recognizing the national relevance of regional challenges and opportunities. For over four years, the Center has served as the administrative home for Better Health Greater Cleveland, an EMR-catalyzed initiative to measure, publicly report, and improve health outcomes for the region's residents with chronic medical problems. Center faculty also assume leadership roles in federally-supported degree programs in Health Services Research and Clinical Investigation and teach in the core curriculum of the School of Medicine.

**Center for Medical Education**

216.368.1948
Patricia A. Thomas, MD, FACP, Director
Klara Papp, PhD, Director, CAML

The Center for Medical Education, established in 2010, provides an organizational home for teaching and learning programs in the School of Medicine and a supportive environment for those who want to develop special skills in medical education.

The Center also sponsors faculty appointments, both full- and part-time, for faculty whose roles are predominantly focused on teaching medical students and physician assistant students. These include community clinicians who welcome medical students into their clinics and practices.

The Center for the Advancement of Medical Learning ("CAML") operates its programs under the auspices of the CMEd. CAML supports and promotes the development of teaching and lifelong-learning skills among students, faculty, staff, residents, and alumni. CAML pursues research into educational innovations to advance our knowledge of medical learning and teaching. The Center offers workshops to faculty locally, regionally, and nationally to enhance faculty teaching, research and evaluation skills.

**Center for Proteomics and Bioinformatics**

216.368.0291
http://proteomics.case.edu/index.html
Biomedical Research Building, Ninth Floor
Mark R. Chance, PhD, Director

The Case Center for Proteomics and Bioinformatics was created, in part, to strengthen Cleveland's presence in modern proteomics and bioinformatics research to make the region a leader in the field. The vision for the Center has been shaped over the past several years by the leadership of the Center’s Director, Mark Chance, PhD, with over $120 million in grants awarded to the Center and its collaborators since its inception in February 2006. One of the primary goals of the CPB is to develop an infrastructure of sophisticated equipment that facilitates and maximizes shared equipment usage, as well as to offer a wide array of proteomics and bioinformatics services including mass spectrometry, protein expression/interactions, systems biology, and biostatistical analyses.

The CPB has expanded its vision to include education of graduate students in systems biology and bioinformatics. The Center for Proteomics and Bioinformatics developed a graduate program in Systems Biology and Bioinformatics in collaboration with Schools and Departments across the campus. For more information regarding the SYBB graduate program please see "Systems/Bioinformatics" tab above. You may also visit http://bioinformatics.case.edu/.

Proteomics entails the in depth structural analysis of individual proteins in human and animal cells. In studying proteins and their changes, bioinformatics enables researchers to take an integrated -omics approach for discovering networks involved in human disease. The School of Medicine has established the Center for Proteomics and Bioinformatics to perform research to better understand the genetic and environmental bases of disease as well as provide new technologies to diagnose diseases such as cancer, heart disease, and diabetes.

New technologies in mass spectrometry are also allowing protein expression, localization, structure, post-translational modifications, and interactions to be studied in increasing detail and on a genome wide scale. The Center is also developing and applying state-of-the-art-structural proteomics technologies to understand the function and interactions of macromolecular complexes.

The CPB has three divisions: Proteomics and Genomics, Bioinformatics, and Macromolecular Structure.

**Proteomics and Genomics Division**

The mission of the Division of Proteomics and Genomics is to support research in protein and gene expression analysis, protein and gene modifications, and protein interactions in a wide variety of biological contexts. The division also develops new tools in Proteomics and Genomics research. This includes multiple Proteomics Cores to support these activities.

**Bioinformatics Division**

The mission of the Division of Bioinformatics is to support interdisciplinary research and training in many areas of bioinformatics including analysis of DNA and protein sequences, protein interaction networks, linkage and association studies for simple and complex traits, and gene and protein expression profiles. This includes a Bioinformatics Core that provides research support for these activities.

**Macromolecular Structure Division**

The mission of the Division of Macromolecular Structure is to support interdisciplinary research in new methods of structure determination, the combination of computational and experimental structural biology approaches, and developing and maintaining infrastructure for macromolecular structure determination. The Division will work closely and coordinate their activities with faculty and Departments in the University who use structural information to understand function as well as other Centers that provide leadership in Structural Biology and Biophysics.

The CPB also offers a wide range of seminars, workshops, and possibilities for individual training. These activities are posted on the CPB Web site. For a list of services and to explore opportunities to
collaborate, please visit the Web site: http://proteomics.case.edu or e-mail: proteomics@case.edu //proteomics@case.edu).

Center for Psychoanalytic Child Development
Kimberly Bell, PhD; John A. Hadden Jr. Assistant Professor of Psychoanalytic Child Development
Email: kmb207@case.edu
216.991.4472

The Center for Psychoanalytic Child Development was established in 2001 in memorial to John A. Hadden Jr., past President of the Board of Trustees of the Cleveland Center for Research in Child Development and of the Hanna Perkins School. The mission of the center is to advance the science of psychoanalytic child development at the School of Medicine.

The Center offers medical students and residents who are interested in working with children the opportunity for observational learning in the Hanna Perkins school. In addition, didactic courses, case conferences and supervision are available to deepen students’ understanding of the relationship between physical and psychological development in the first 5 years of life.

The Center for RNA Science and Therapeutics
216.368.0299
http://www.case.edu/med/rnacenter/home.htm
Jeffery M. Coller, PhD, Director

The Center for RNA Science and Therapeutics is a free standing academic unit in the basic sciences within the School of Medicine at Case Western Reserve University. The RNA Center was established in the mid-nineties as a core entity in recognition of the strong cadre of research laboratories devoted to studying post-transcriptional mechanisms of gene expression focusing on various aspects of RNA Biology. The current mission of the RNA Center is to parlay the strengths of RNA Center scientists towards the development of unique therapeutic initiatives. The RNA Center is combining the usage of nanoparticle technology with RNA science to develop new classes of drugs, leading towards the amelioration of a variety of diseases. Current efforts are focused on metabolic disorders, cancer immunotherapies, immunity, and protein replacement. In addition, we are developing new technologies that promise to improve diagnostics, allowing for earlier detection of a variety of human diseases, especially cancer.

The RNA Center contains one of the largest concentrations of RNA scientists in the nation. The faculty of the RNA Center cover nearly every aspect of RNA research. Current research in the Center focuses on several problems ranging from extremely basic questions such as the mechanism of RNA catalysis and how proteins interact with RNA to the roles of RNA processing in disease. Specific research interests include splicing and its regulation, RNA editing, tRNA maturation, mechanisms of translation regulation, RNA degradation, RNA trafficking, RNA interference and regulation of gene expression by microRNAs and non-coding RNAs.

Collectively, the RNA Center provides a valuable resource for collaborative efforts within the University and its affiliated institutions: the Cleveland Clinic Foundation, MetroHealth Medical Center, the Cleveland VA Medical Center, and University Hospitals Cleveland Medical Center. In addition, the official journal of the RNA Society “RNA” was founded and continues to be housed in the RNA Center. The members of the RNA Center have an excellent funding record and the research performed is regularly published in highly visible journals such as Science, Nature, Molecular Cell, NSMB, Molecular Cell, etc.

Center for Science, Health and Society
216.368.2059
http://casemed.case.edu/cshs/
Nathan A. Berger, MD, Director

Recognizing that the successful futures of Case Western Reserve University, the City of Cleveland, and Cuyahoga County are integrally related, the Center for Science, Health and Society (CSHS) was created in 2002 to focus the efforts of the University and the community in a significant new collaboration to impact the areas of health and healthcare delivery systems through community outreach, education, and health policy. The Center, based in the School of Medicine, with university wide associations, is engaging the many strengths of the University and the community to improve the health of the community.

The Center has engaged the community at the level of the individual and the neighborhood, in public and private schools, at civic and faith-based organizations, and at the level of governmental agencies and community leadership to identify community problems, perceptions, assets and resources; advise the community of faculty skills, assets and expertise; and, catalyze that community service based scholarship that benefits community interests and promotes mutual enhancement. The Center coordinates the Scientific Enrichment Opportunity outreach program that brings Cleveland high school students on to the medical school campus in the summer to work along with our distinguished faculty in their research labs, to introduce and stimulate the students and help prepare them to enter careers in the health career professions and biomedical workforce. The Center also coordinates the Mini Medical School Program presented every Spring and Fall to educate the community in the latest developments in healthcare, particularly those developed at CWRU. The overall goal of these programs is to educate and empower the community to become better consumers of healthcare and more informed and stronger advocates for healthcare policy and legislation in their own interests.

Center for the Study of Kidney Biology and Disease
216.444.8415
John R. Sedor, MD, Director
Thomas H. Hostetter, MD, Co-director
Jeffrey Garvin, MD, PhD, Co-director
Jeffrey Schelling, MD, Co-director

Chronic Kidney Disease (CKD) is a growing public health problem in the United States. More than seventeen percent of US adults—more than 30 million Americans—have CKD. CKD generally progresses over time, and can cause cardiovascular disease, anemia, bone disease, fluid overload, and eventually end-stage kidney disease (ESKD). Patients with ESKD need renal replacement therapy, either from dialysis or a kidney transplant, to live. The risk of death for patients receiving dialysis is nearly eight times higher than the non-ESRD population, leading to a 20% annual probability of death. Kidney disease disproportionately affects minorities and vulnerable populations. Kidney disease treatment is expensive and uniquely tied to federal expenditures through the Medicare entitlement program. The cost of care for ~ 550,000 ESKD patients is nearly $34 billion annually, exceeding the total NIH budget. Treating all
The Center focuses on the application of electrical currents to either generate or suppress activity in the nervous system. This technique is known as functional electrical stimulation (FES). FES can produce and control the movement of otherwise paralyzed limbs for standing and hand grasp, activate visceral bodily functions such as bladder control or respiration, create perceptions such as skin sensibility, arrest undesired activity such as pain or spasm, and facilitate natural recovery and accelerate motor relearning.

The Cleveland Functional Electrical Stimulation (FES) Center

216.231.3257
Robert F. Kirsch, PhD, Executive Director
Robert Ruff, MD, PhD, Medical Director

The Cleveland Functional Electrical Stimulation (FES) Center (http://fescenter.org) is a consortium of three nationally recognized institutions: Department of Veterans Affairs, MetroHealth Medical Center and Case Western Reserve University. Through the support of these partners, the Cleveland FES Center is able to provide a continuum of advancement. Created in 1991 with a grant from the Department of Veterans Affairs, the FES Center currently has research funding at the federal, state and local levels and additional industry and foundation funding in excess of $17M in order to achieve its mission.

The Center focuses on the application of electrical currents to either generate or suppress activity in the nervous system. This technique is known as functional electrical stimulation (FES). FES can produce and control the movement of otherwise paralyzed limbs for standing and hand grasp, activate visceral bodily functions such as bladder control or respiration, create perceptions such as skin sensibility, arrest undesired activity such as pain or spasm, and facilitate natural recovery and accelerate motor relearning.

The Center for Translational Neuroscience

216.368.6116
David M. Katz, PhD, Director

The goals of the Center for Translational Neuroscience are to develop scientific interactions that promote understanding of the pathology of neurological diseases and to develop novel therapeutic strategies for the treatment of those diseases. The Center pursues these goals through Translational Interest Group meetings and events, and through the Neurological Institute, in the University Hospitals Case Medical Center, where clinicians and investigators have a direct conduit between research and developing treatments.

The Mt. Sinai Skills and Simulation Center

216.368.0064
Mark I. Aeder, MD, Medical Director

The Mt. Sinai Skills and Simulations Center (MSSSC) (http://casemed.case.edu/simcenter) was initially conceived in response to common concerns over the nationwide increased incidence of medical errors, the rising costs of health care, and the need for improved patient-caregiver communication. Since its founding in 2006, the MSSSC continues to work with an ever expanding list of health care partners to become an integral resource for the education of health care students and professionals in the Northeastern Ohio region and throughout Ohio. The MSSSC and The Institute for Surgical Innovation (ISI) combine to form the Case Western Reserve University Center for Skills and Simulation (CWRU-CSS).

Simulation develops confident practitioners who can significantly contribute to the goal of improved patient outcomes. By providing a variety of simulation tools, such as life-like computerized manikins and standardized professionals performing within carefully crafted scenarios, we can replicate the complex environment of the clinical setting. Participation in these specially designed scenarios allows learners to practice the critical skills needed to provide safe, quality care to patients, including communication, technique development, decision making and data analysis. These models have allowed us to have ongoing research projects in education development and intervention and advanced our partnership for the development of new techniques and materials.
The MSSSC has all the tools available for simulation training, including Standardized patients — individuals trained to portray situations or conditions; Task trainers — devices used to teach individual techniques; High fidelity trainers — manikins with programming capabilities; Virtual reality — real life interactive trainers for surgery, cardiology and other disciplines; Second life — avatar interactions in a computerized world; and Hybrid combinations of the above.

The CWRU-CSS is an American College of Surgeons Level 1 Accredited Educational Institute. During the past five years, the Center has provided educational opportunities and course for learners at all levels from high school students, medical, dental and nursing students at Case Western Reserve University and The Lerner College of Medicine, residents and fellows from training programs at University Hospitals Case Medical Center, The Cleveland Clinic and MetroHealth Medical Center, graduate education for practicing physicians and surgeons, nursing and other health care providers at all levels, first responders including EMS and fire/rescue, flight nurse training and military reserve medical units.

National Center for Regenerative Medicine
216.368.3614
http://ncrm.us
Stanton L. Gerson, MD, Director
Jeremy Rich, MD, PhD, Co-Director
Mariesa Malinowski, Executive Director

The Center for Regenerative Medicine (http://ncrm.us) is a multi-institutional center composed of investigators from Case Western Reserve University, University Hospitals Case Medical Center, the Cleveland Clinic, Athersys, Inc., and The Ohio State University. Building on over 30 years of experience in adult stem cell research in northeast Ohio, the Center was created in 2003 with a $19.4 million award from the State of Ohio as a Wright Center of Innovation. An additional $8M award in 2006 from the State of Ohio's Biomedical Research and Commercialization Program (BRCP) was successfully completed and enabled 3 new clinical trials to enroll patients. In 2009, $5M was awarded by the Ohio Third Frontier (OTF) Research Commercialization Program (RCP) which further validated the Center’s ability to achieve its mission to utilize human stem cell and tissue engineering technologies to treat human disease. In 2010, $1M was awarded to the NCRM by the OTF Biomedical Program (OTFBP) to advance the clinical treatment of spinal cord injury, and a $2.1M OTF Wright Program Project (WPP) award was made to create a consortium of quantitative analysis imaging systems for stem cells.

Neural Engineering Center
216.368.3978
Dominique M. Durand, PhD, Director
Kenneth Gustafson, PhD, Associate Director

The Neural Engineering Center (NEC) (http://www.case.edu/cse/nec) is a coordinated group of scientists and engineers dedicated to research and education in an area at the interface between neuroscience and engineering. They share the common goal of analyzing the function of the nervous system, developing methods to restore damaged neurological function, and creating artificial neuronal systems by integrating physical, chemical, mathematical, biological and engineering tools.

The center was started in 2001 and replaced the Applied Neural Control Laboratory (ANCL) started in 1972. The center offers breadth and depth in Neural Engineering research and education in a highly ranked biomedical engineering department and medical school. The center is located on the campus of Case Western Reserve University and its members collaborate with four major hospitals in the Cleveland area.

The center provides core facilities in tissue culture, microscopy and histology. The center facilities also include an electrode fabrication laboratory, surgical suite for acute and sterile surgery, staffed by two full time animal technicians. The center also holds several laboratories in neural regeneration, neural interfacing, neural prosthetics, materials for neural interfacing computer modeling and in-vitro electrophysiology. The students, research associates and faculty can carry out research at many levels starting from cellular and molecular to animal experimentation and into the clinic. Many other facilities such as electronic design, microfabrication and rapid prototyping are also available in collaboration with other closely related centers, the Functional Stimulation Center (FES) and the Advanced Platform development Laboratory (APT). Center members work closely with the partner hospitals and the technology transfer office of CWRU for translation and clinical implementation of solutions restore neural function such as development of electrodes for communication with the nervous system, regenerating neural tissue, restoring function in paralysed patients, preventing seizures, motor disorders, incontinence aspiration or obstructive sleep apnea.

The center provides financial support for students through research and training grants. The graduates of this program have made significant contributions to the development and the growth of this fast growing area of neural engineering in academic, industrial and federal institutions.

Prevention Research Center for Healthy Neighborhoods
216.368.1918
Elaine A. Borawski, PhD, Director

The Prevention Research Center for Healthy Neighborhoods (PRCHN) (http://casemed.case.edu/ctsc/community/prevention.cfm) at Case Western Reserve University was established in 2009 with funding from the Centers for Disease Control and Prevention (CDC). Built upon the foundation of two previous centers that merged to become the PRCHN - the Center for Health Promotion Research and the Center for Adolescent Health - the PRCHN seeks to foster partnerships within Cleveland's neighborhoods for developing, testing, and implementing research strategies to prevent and reduce the burden of chronic disease. The PRCHN, midway into its second 5-year cycle of CDC funding, is a highly responsive and collaborative community-based research center that partners with public health agencies, community organizations, neighborhood leaders and residents to address significant environmental and lifestyle issues strongly linked to chronic disease and influenced by the conditions, disparities and resources of the neighborhood itself.

Its faculty and staff have also served as an active partner and leader in the transformative process occurring in Cleveland around the concepts of health equity, collective action, and the understanding of multiple determinants of health.

The PRCHN supports a comprehensive research agenda that centers around food access and community nutrition, tobacco prevention and cessation, environments supporting healthy eating and active living, place-based health and health behavior surveillance, and community-clinical linkages and chronic disease management research. This includes core research project, Freshlink, that aims to increase nutritional food access (NFA) in low income neighborhoods throughout Cleveland.

A goal of the PRCHN is to build capacity for community-based research among University and community partners by offering formal training programs (i.e., PEER Program, PRCHN Student Internship Program)
monthly seminars, workshops and webinars, and by providing technical assistance, evaluation services and subject matter expertise to its community partners.

The PRCHN partners include experienced community based researchers, heads of local boards of health, more than 50 community and health organizations, neighborhood leaders and residents, and Affiliated Faculty from five schools within the University (College of Arts and Sciences, the Frances Payne Bolton School of Nursing, the Mandel School of Applied Social Sciences, and the School of Dental Medicine), to support the mission of the Center. Representatives from these local agencies and organizations serve on the PRCHN's Network of Community Advisors (NOCA), offering guidance to identify emerging issues, set research and programmatic priorities, and ensure that the community's voice informs our work.

**Skin Cancer Research Institute**  
216.368.0324  
Kevin D. Cooper, MD, Director

The Skin Cancer Research Institute (http://mediswww.case.edu/dept/dermatology/Centers/SCRI.html) engages the foremost experts in dermatology and oncology to work collaboratively across disciplines to identify new ways to treat and prevent skin cancers. The Skin Cancer Research Institute (SCRI) at Case Western Reserve University exists to discover causes of skin cancers, prevent skin cancers more effectively, and to develop new therapies for skin cancer treatment.

The Department of Dermatology is poised to create a research institute unique in scope on a national scale. Its efforts are validated by generous grant funding from the National Institutes of Health as well as through its continuous stream of groundbreaking discoveries over the past decade. What exists now within this rich infrastructure is an opportunity to transform discovery in skin cancer research. CWRU plans four new centers exclusively dedicated to the study of skin cancer, which will complement existing centers of excellence in the Department. The emerging centers will include a melanoma center, a basal/squamous cell carcinoma center, a photo medicine center, and an environmental agent center.

The Skin Cancer Research Institute has an opportunity to be unique in the nation in its capacity to bring new therapies "from lab to life" by aligning specialized skills and catalyzing new knowledge through these centers.

**The Stem Cell Ethics Center**  
216.368.0881  
Insoo Hyun, PhD, Director

The CWRU Stem Cell Ethics Center (https://case.edu/medicine/bioethics) serves as a focal point for campus-wide and international interdisciplinary scholarship and education. House in the Department of Bioethics, the Stem Cell Ethics Center provides an avenue to educate policy makers, regulators, and the general public about stem cell research of all forms and their translation to clinical practice. The Stem Cell Ethics Center bridges ethics and biotechnology by providing ethical and technical support, as well as a forum for directed application of stem cell ethics in the complex array of cultural, social, political, and economic issues.

**The Swetland Center for Environmental Health**  
216.368.5437  
http://casemed.case.edu/swetland/  
Li Li (li.li@case.edu), MD, PhD, Director

The mission of the Mary Ann Swetland Center for Environmental Health is to study the complex interplay between the environment and health. The center places special emphasis on investigating the environmental determinants of health disparity, and translating the findings into practices and programs that promote community and population health.

The environments in which we live, work and play have a great impact on our health. Environmental health embraces all the physical, psychosocial, and biological factors that affect health. Today, the Swetland Center continues Mary Ann Swetland's legacy, promoting awareness of the environment's disparate impact on disadvantages populations.

The strategic vision of the Swetland Center is:

- Promoting translational environmental health research
- Integrating environmental health science into medical education
- Engaging the community in environmental health sciences

**The Visual Sciences Research Center**  
216.368.4752

Irina Pikuleva, PhD, Director  
Nancy Vitale, Administrative Manager

The Visual Sciences Research Center (VSRC) was founded at Case Western Reserve University in 1996 and its mission is to promote the study of basic and clinical problems of the eye and visual system, expectantly leading to improvements in the prevention and treatment of major blinding disorders. The VSRC now comprises a multidisciplinary and comprehensive research program in vision and ophthalmology, with 30 members in different departments including Ophthalmology and Visual Sciences (http://case.edu/med/ophthalmology), Pharmacology (http://pharmacology.case.edu), Chemistry (http://chemistry.case.edu), Medicine (http://medicine.case.edu), Molecular Biology (http://case.edu/med/microbio), Population and Quantitative Health Sciences (http://epibwww.case.edu) (formerly Epidemiology & Biostatistics), Neurosciences (http://case.edu/medicine/neurosciences), Pathology (http://case.edu/med/pathology), Pediatrics (http://casemed.case.edu/pediatrics), and Proteomics (http://proteomics.case.edu). VSRC scientists study basic and clinical aspects of the eye and focus on Retinal Degeneration, Aging and Diabetes, Biochemistry of Aging Lens, as well Glaucoma. Also, through multidisciplinary and comprehensive research involving both basic and clinical departments, the VSRC seeks to advance the visual sciences at the University and to promote its efforts to the scientific community.

The VSRC is supported by a National Eye Institute (NEI) (https://www.nei.nih.gov) funded P30 Core Grant (EY11373) (http://case.edu/med/ophthalmology/VisualSciencesResearchCenter.html/TheCOREModules.html) and an NEI T32 Training Grant (EY007157), as well as generous contributions from both the university and University Hospitals.

The P30 grant supports four Core Modules, which enhance research quality in the most efficient and economical manner. The Core Modules are: Molecular Biology (http://case.edu/...
The Cystic Fibrosis Research Center is a translational center composed of investigators from Case Western Reserve University and University Hospitals of Cleveland. The Center’s research is funded by over $4 million in grants from the National Institutes of Health, the Cystic Fibrosis Foundation and other sources. The Center provides core facilities and services for investigators carrying out research related to cystic fibrosis, including a Clinical Studies core that provides clinical data for research studies and aids in IRB generation and study design, an Animal Models core that maintains the world’s largest assortment of CF mouse models, a Bioanalyte core that measures a range of biomolecules (proteins, lipids, mRNA) from blood, tissues or cell culture, an Animal Imaging core that uses such technologies as MRI, PET and SECT to generate high resolution images of rodents, a Biostatistical core to carry out complex statistical analyses of CF related studies, a Histology core that generates slide-mounted and stained sections of tissues from animal or human samples and a Cell Culture core that provides facilities and media for cultured cells. These cores facilitate translational, or “bench to bedside” projects that take very mechanistic, basic research on CF-related biochemistry and cell biology to in vivo studies in animal models and on to humans. Center members have access to all the cores as well as involvement in the weekly seminar series focused on CF or pediatric pulmonary research.

Willard A. Bernbaum Cystic Fibrosis Research Center
216.368.6896
Mitchell Drumm, PhD and Michael Konstan, MD, Co-Directors
Constance May, Administrative Assistant

The Cystic Fibrosis Research Center is a translational center composed of investigators from Case Western Reserve University and University Hospitals of Cleveland. The Center’s research is funded by over $4 million in grants from the National Institutes of Health, the Cystic Fibrosis Foundation and other sources. The Center provides core facilities and services for investigators carrying out research related to cystic fibrosis, including a Clinical Studies core that provides clinical data for research studies and aids in IRB generation and study design, an Animal Models core that maintains the world’s largest assortment of CF mouse models,
Doctor of Medicine (MD)

Programs Leading to MD

Today, applicants can choose from three programs to obtain a medical degree at Case Western Reserve University: the University Program, the College Program (Cleveland Clinic Lerner College of Medicine of Case Western Reserve University), and the Medical Scientist Training Program (http://mstp.case.edu/default.asp). Students in all three programs:

- are introduced to clinical work and patients almost as soon as they arrive on campus.
- learn medicine using an integrated, system-based approach.
- are treated as junior colleagues by faculty members.
- are taught the science of medicine infused with the skills of communication and compassion.
- learn how to learn– a skill they will call on throughout their careers in the quickly changing field of medicine.

Educational Authority

Governance of the educational programs leading to the medical degree resides in the Faculty of Medicine. Each class of students selects representatives who become voting members of the Faculty of Medicine. The faculty of the School of Medicine is responsible for the content, implementation and evaluation of the curriculum. The Dean of the School of Medicine serves as its chief academic officer, with overall responsibility to the university for the entire academic program. The Vice Dean for Medical Education carries the Dean’s academic and
The faculty’s Committee on Medical Education (CME) evaluates, reviews and makes recommendations concerning overall goals and policies of the School’s medical education program, which includes the University and College programs. Acting for the faculty, the Committee on Medical Education is responsible for 1) the formal approval and adoption of the School’s educational program objectives and ongoing monitoring to ensure that the objectives serve as guides for establishing curriculum and provide the basis for evaluating program effectiveness; 2) the review of performance in each program’s competencies; and 3) the evaluation of the overall content and appropriateness of the educational programs and curricula leading to the MD degree. The faculty elects the majority of the members of the Committee on Medical Education; student representatives also serve on this committee and its curriculum councils.

The operational responsibility for the medical curriculum is invested in curriculum committees that report to the Committee on Medical Education. There are four curriculum committees: (a) the WR2 Curriculum Committee (University Program), (b) the Program Evaluation and Assessment Committee (University Program), (c) the Curriculum Steering Council (College Program), and (d) the Joint Clinical Oversight Group. These committees are responsible for the strategic planning, content, design, selection of teaching leadership, and oversight of the curriculum, student assessment and program evaluation.

Expectations for Personal and Professional Characteristics

Students are evaluated on knowledge base, clinical skills and professional behavior and attitudes. The following characteristics are evaluated throughout the medical curriculum, and students are expected to adhere to these standards in both their academic and personal pursuits:

**Interpersonal relationships:** Provide supportive, educational and empathetic interactions with patients and families, and is able to interact effectively with “difficult” patients. Demonstrates respect for and complements roles of other professionals, and is cooperative, easy to work with, commanding respect of the health care team.

**Initiative:** Independently identify tasks to be performed and makes sure that tasks are completed. Performs duties promptly and efficiently, and is willing to spend additional time, assume new responsibilities, and able to recognize the need for help and ask for guidance when appropriate.

**Dependability:** Complete tasks promptly and well. Present on time and actively participates in clinical and didactic activities. Always follows through and is exceptionally reliable.

**Attitude:** Are actively concerned for others. Maintain a positive outlook toward assigned tasks. Recognizes and admits mistakes. Seeks and accepts criticism, using it to improve performance.

**Integrity and honesty:** Demonstrate integrity. Is honest in professional encounters. Adheres to professional ethical standards.

**Tolerance:** Demonstrate exceptional ability to accept people and situations. Acknowledges her or his biases and does not allow them to affect patient care.

**Function under stress:** Consistently maintain professional composure and exhibits good clinical judgment in stressful situations.

**Appearance:** Always display an appropriate professional appearance.

Graduation Requirement

To graduate from CWRU School of Medicine with the MD degree (or the MD degree with Special Qualifications in Biomedical Research for students in the Cleveland Clinic Lerner College of Medicine program), students must:

1. Satisfactorily complete all Program Specific Requirements and Educational Program Objectives of the School of Medicine
2. Pass the USMLE Step 1 and USMLE Step 2 CK and CS
3. Pass or remediate the School of Medicine’s Clinical Skills Exam
4. Satisfactorily complete the MD Thesis
5. Meet financial obligations to the University
6. Be approved to graduate by the Committee on Students

Licensure

Licensure to practice medicine in the United States and its territories is a privilege granted by the individual licensing boards of the states and territories. Each licensing board of the individual jurisdictions establishes its policies, eligibility and requirements for the practice of medicine within its boundaries pursuant to statutory and regulatory provisions. The degree of doctor of medicine awarded by Case Western Reserve University is an academic degree and does not provide a legal basis for the practice of medicine.

Learning Management System

The School of Medicine uses an integrated Learning Management System for all years of the medical education program that conveniently organizes courses, associated learning expectations, and resources to support learning in the curriculum. The learning resources include references to traditional textbooks and journal articles, as well as PowerPoint presentations, illustrations, animations, videos, audio files, and links to Internet-based learning tools.

University Program students have access to the Internet and their curricular material via gigabit Ethernet connections to the CWRU network and via an extensive campus-wide wireless access as well as access from any other Internet connection. Cleveland Clinic Lerner College of Medicine students have access to the Internet and the College Program curriculum via wireless access at the Cleveland Clinic or anywhere else they have an Internet connection.

Medical Student Organizations

The list of organizations and activities available to medical students continually evolves to reflect the interests of current students. Visit here for the most up-to-date list of student organizations (http://www.casemed.org/student-groups1.html). (http://casemed.case.edu/admissions/studentlife/organizations.cfm)

Admission

There are three paths to a medical degree at Case Western Reserve University School of Medicine: the University Program (4 yr. MD), the Cleveland Clinic Lerner College of Medicine of Case Western Reserve University (College Program - 5 yr. MD), and the Medical Scientist Training Program.
Program (MSTP). Inquiries about admission and application should be addressed to the appropriate office:

**Office of Admissions-University Program**
School of Medicine, T-308
10900 Euclid Avenue
Cleveland, Ohio 44106-4920
Phone: 216.368.3450 or casemed-admissions@case.edu

**Office for Admissions and Student Affairs-College Program**
Cleveland Clinic Lerner College of Medicine of Case Western Reserve University
9500 Euclid Avenue NA21
Cleveland, Ohio 44195
Phone: 216.445.7170 or 866.735.1912 or cclcm@ccf.org (//cclcm@ccf.org)

**Medical Scientist Training Program**
School of Medicine
Case Western Reserve University
10900 Euclid Avenue
Cleveland, Ohio 44106-4936
Phone: 216.368.3404 or mstp@case.edu

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**Getting Started**

Students wishing to apply to any MD program at the School of Medicine must initiate this electronic process through the American Medical Colleges Application Service (AMCAS). Visit AMCAS (https://www.aamc.org/students/applying/amcas) to learn more about the medical school application process.

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**Admissions Process**

After the American Medical College Application Service (https://students-residents.aamc.org/applying-medical-school/applying-medical-school-process/applying-medical-school-amcas) (AMCAS) is completed the applicant receives an e-mail directing him or her to the CWRU School of Medicine online secondary (final) application where the applicant can designate to which MD program(s) they wish to apply. Applicants can apply to both MD programs and/or the MSTP. It is possible for an applicant to be interviewed by and receive an admission offer from all three programs.

Applicants should complete this secondary application as instructed. After the applicant has submitted the secondary application and all supporting materials, the appropriate admissions subcommittee will review the information and decide whether to invite the applicant for an interview. After the interview, the Admissions Committee of the CWRU SOM will discuss each applicant and decide whether to extend an offer of admission.

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**Admissions Criteria**

Although academic credentials are important in the admissions process, high grades and a high score on the MCAT are not the only criteria for admission. Just as important are interpersonal skills, exposures to medicine, well-roundedness and qualities such as professionalism, empathy and leadership ability. The School of Medicine includes a widely diverse student body.

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**Academic Requirements**

Given the variability in the way undergraduate institutions structure various courses, there is some flexibility with some of our pre-requisite courses. Please closely review the pre-requisite charts (http://case.edu/medicine/admissions/application-process/requirements) for each program.

If these pre-requisites were not fulfilled at an accredited, four-year, degree-granting American or Canadian college or university, the applicant should be prepared to take at least 1 year of challenging, upper-level sciences at one of these institutions prior to application.

If all science pre-requisites were taken at a community college, the committee strongly recommends that the applicant take at least one year of upper-level sciences from an accredited four-year degree granting university within the United States or Canada. If a few science pre-requisite courses were taken at a community college, the committee will evaluate them on a case-by-case basis.

Undergraduate students should pursue a major in a subject of their own choosing; they should not structure their undergraduate experiences in an attempt to sway the medical school admissions committee but instead, base it on their own personal interests and goals.

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**Financial Aid**

About 70 percent of the University Program’s medical students receive some financial aid based strictly on financial need. It’s impossible to provide precise figures on financial aid before each specific situation is completely analyzed, but here is a description of the general aspects of the process:

The School of Medicine adheres to the unit loan concept used by most private medical schools. Under this concept, if a student qualifies for financial aid, he or she is expected to obtain a specific portion of his or her support from outside sources such as a Federal Direct Loan, savings and family. Once the student obtains this amount, the remaining aid would be provided through School of Medicine resources, up to the amount determined to be his or her reasonable need. The school’s contribution would be a combination of loan and scholarship, with the exact ratio determined by the student’s particular circumstances.

All students within the College Program receive full scholarship covering tuition and fees. Additionally, the Medical Scientist Training Program offers financial support for participants. For more information, see other entries in this publication and contact the specific program.

The University Program each year offers a number of merit scholarships to each class through its Dean’s Scholars program. These scholarships, which vary in annual amounts, are awarded for up to four years for selected students. Application for the scholarships is by invitation of the Admissions Committee. Recipients are students with records of exceptional academic and personal achievement.

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**Overview of the University Program**

The School of Medicine curriculum always has reflected the most current educational principles, practices, and knowledge. In the 1950s the School of Medicine was the first to introduce the organ systems approach to teaching the basic sciences. In July 2006, the University Program launched the Western Reserve2 Curriculum (WR2) to develop a learner-centered and self-directed curriculum framework and implement dynamic
small group learning teams. Students learn in an environment that fosters scientific inquiry and excitement.

**The University Program in Detail**

The WR2 Curriculum has high expectations for self-directed learning, and seeks to train physician scholars who are prepared to treat disease, promote health and examine the social and behavioral context of illness. It interweaves four themes - 1) research and scholarship, 2) clinical mastery, 3) teamwork and leadership, and 4) civic professionalism and health advocacy to prepare students for the ongoing practice of evidence-based medicine in the rapidly changing healthcare environment of the 21st century.

Scholarship and clinical relevance are the benchmarks for learning, and clinical experiences and biomedical and population sciences education are integrated across the four years of the curriculum. The WR2 Curriculum also creates an independent, educational environment where learning is self-directed and where student education primarily occurs through:

1. facilitated, small-group student-centered discussions
2. large group interactive sessions such as Team-Based Learning or didactic sessions that offer a framework or synthesis
3. interactive anatomy sessions
4. clinical skills training
5. patient-based activities

Clinical experiences begin in the first week of the University Program when students participate in community-based health care field experiences. In January of the first year, the Community Patient Care Preceptorship (CPCP) rotations begin. Each student works with a community physician one afternoon a week for 3 months.

Research and Scholarship begin early in the curriculum with special sessions led by faculty engaged in cutting edge research. In the summer following year one, the majority of students engage in summer research opportunities. All students participate in a mentored 16-week experience in research and scholarship and complete an MD thesis prior to graduation.

Electronic resources make the most of classroom time while improving opportunities for self-directed learning and capitalizing on the innovative technology available at Case Western Reserve University.

A key component of the University Program is the unscheduled time on Thursday mornings and some weekday afternoons. Students use this time for self-directed learning as well as to pursue a joint degree, take electives, participate in interest groups, shadow a practicing physician, or become active in student organizations.

Each student in the University Program is a member of one of the following advising societies: Blackwell-McKinley Society, Robbins Society, Satcher Society, or Wearn Society. Each society is headed by an advising dean, who helps the students navigate the curriculum, advises them on residency and career planning, and writes their dean's letters. The society deans hold regularly scheduled small group and individual meetings with the students. The society deans are all members of the faculty of the School of Medicine and participate actively in the educational programs of the school. Some aspects of the curriculum are coordinated through the societies.

**Education throughout the Four Years is Centered on:**

1. Fostering experiential and interactive learning in a clinical context;
2. Stimulating educational spiraling by revisiting concepts in progressively more meaningful depth and increasingly sophisticated contexts;
3. Promoting integration of the biomedical and population sciences with clinical experience;
4. Transferring concepts and principles learned in one context to other contexts;
5. Enhancing learning through deliberate practice, or providing learners with direct observation, feedback, and the opportunity to practice in both the clinical environment and in the Case Western Reserve University (CWRU) School of Medicine's Mt. Sinai Skills and Simulation Center.

**The Western Reserve2 Curriculum has 10 Guiding Principles:**

1. The core concepts of health and disease prevention are fully integrated into the curriculum.
2. Medical education is experiential and emphasizes the skills for scholarship, critical thinking, and lifelong learning.
3. Educational methods stimulate an active interchange of ideas among students and faculty.
4. Students and faculty are mutually respectful partners in learning.
5. Students are immersed in a graduate school educational environment characterized by flexibility and high expectations for independent study and self-directed learning.
6. Learning is fostered by weaving the scientific foundations of medicine and health with clinical experiences throughout the curriculum. These scientific foundations include basic science, clinical science, population-based science, and social and behavioral sciences.
7. Every student has an in-depth mentored experience in research and scholarship.
8. Recognizing the obligations of physicians to society, the central themes of public health, civic professionalism and teamwork & leadership are woven through the curriculum.
9. The systems issues of patient safety, quality medical care, and health care delivery are emphasized and integrated throughout the curriculum.
10. Students acquire a core set of competencies in the knowledge, mastery of clinical skills and attitudes that are pre-requisite to graduate medical education. These competencies are defined, learned and assessed and serve as a mechanism of assessment of the school’s success.

**Curricular Composition**

The four years of the WR2 Curriculum are divided into four major components, each of which focuses on health as well as disease.

**Foundations of Medicine and Health**

This component is made up of six curricular blocks.

The first block, **Becoming a Doctor**, is five weeks in duration, and gives students an understanding of population health and the doctor's role in society. Typically students begin their medical education by studying basic science at the molecular level, and are often not fully aware of the relevance that this knowledge has in their future education as physicians or how it relates to the actual practice of medicine. This curricular block focuses on how physicians can act as advocates for their patients in the health care system; how social and environmental factors impact health;
and the importance of population health. Medical students participate in an Extensive Care Unit, an experiential, longitudinal, service learning project intended to introduce them to key population health concepts including epidemiology, biostatistics, community assessment, health risk behavior, and social-environmental determinants of health.

The next five blocks in the Foundations of Medicine and Health are comprised of basic science education complemented by clinical immersion experiences, early contact with patients in clinical preceptorships and simulated clinical experiences. Subject matter is integrated across entire biological systems, which permits faculty in the different disciplines to leverage teaching time to convey content and concepts common to their disciplines. Content is divided into the following blocks:

- **The Human Blueprint**: Comprised of endocrine, reproductive development, genetics, molecular biology, and cancer biology.
- **Food to Fuel**: Encompasses gastro-intestinal system, nutrition, energy, metabolism and biochemistry.
- **Homeostasis**: Includes cardiovascular system, pulmonary system, renal system, cell regulation, and pharmacology.
- **Host Defense and Host Response**: Focuses on host defense, microbiology, blood, skin, and the auto-immune system.
- **Cognition, Sensation and Movement**: Comprised of neurosciences, mind, and the musculoskeletal system.

Several concepts and themes stretch longitudinally across these blocks, including **Structure** (anatomy, histopathology and radiology) and clinical mastery. Teamwork, interprofessional collaboration and bioethics are likewise incorporated longitudinally.

Blocks 2-6 follow a common pattern. Each block has a Clinical Immersion Week and each has a Reflection and Integration Week. During the Clinical Immersion Week, students leave the classroom and enter the clinical setting to see the relevance of the basic science they have been studying as the concepts are used in the setting of patient care.

The Reflection and Integration week is the final week of blocks 2-6. During this week, no new material is introduced. Learning activities are planned to help students spiral back to concepts introduced earlier in the block by presenting these concepts again, sometimes in new contexts, and now integrated with other concepts previously learned. End of block assessment takes place during the reflection and integration week.

**Research and Scholarship**

The WR2 Curriculum is in concert with CWRU’s emphasis on research and scholarship to encourage student career development in the areas of clinical investigation and population research. The practice of medicine is becoming increasingly evidence and science-based, and research teaches students a way of framing questions and developing an approach to answering them. The focus on research and scholarship provides medical students with opportunities to pursue individualized areas of interest in great depth. Through this 16-week, mentored experience in research and scholarship (which can be taken at any point from March of the second year onward), students acquire the intellectual tools needed to formulate research questions, critically assess scientific literature and continue the life-long pursuit of learning that is a critical aspect in the careers of all physicians and physician/scientists. The research project culminates in a thesis, which is written in the format of a manuscript of the leading journal in the particular area of interest.

**Clinical Experiences**

The clinical curriculum cuts across all four years of the medical school curriculum, and can be divided into three areas of involvement:

1. **Foundations of Clinical Medicine**

   This segment of the clinical curriculum runs longitudinally through the Foundations of Medicine and Health and seeks to develop a broad range of clinical and professional capabilities. FCM develops the necessary skill sets through 4 separate, but integrated, programs:

   - **Tuesday Seminars**: Course continues the theme of “doctoring” begun in Block 1 through the Year 1 and Year 2 curriculum. Topics examined include the relationship between the physician and the patient, the family and the community; professionalism; healthcare disparities; cultural competence, quality improvement; law and medicine; medical error/patient safety, development of mindful practitioners and end of life issues.

   - **Communications in Medicine**: Course is comprised of seven workshops running through Year 1 and Year 2 that focus on the range of skills needed for effectively talking with patients including the basic medical interview, educating patients about a disease, counseling patients for health behavior change, and presenting difficult news and diagnosis.

   - **Physical Diagnosis**: Course runs throughout Year 1 and Year 2 and includes: Physical Diagnosis 1 introducing the basic adult exam to Year 1 students for one session per week for eight weeks, Physical Diagnosis 2 in depth regional exams in various formats during Year 1 and Year 2, and Physical Diagnosis 3 in Year 2 where students spend five session doing complete histories, physicals and write ups on patients they see in an in-patient setting.

   - **Patient-based Programs**: Community Patient Care Preceptorship (CPCP) during either Year 1 or Year 2 students spend 10 afternoons in a community physician’s office developing and reinforcing medical interviewing, physical exam and presentation skills (written and oral) with ongoing mentorship from a preceptor.

2. **Core Clinical Rotations**

   The Core Clinical Rotations are designed to provide students from both the University and College programs of the Medical School with both breadth and depth in clinical care. Experiences are developmental, with opportunities to reinforce, build upon, and transfer knowledge and skills from all parts of the curriculum. Clinical learning is integrated across disciplines whenever possible through a unique block structure, and important themes related to scholarship, humanism, and science are supported through specially designed weekly small group programs. A unified approach to addressing and assessing a core clinical curriculum is utilized at all teaching sites with the flexibility to take advantage of the unique strengths of each clinical setting.

   **Core Rotations**: Beginning in March of their second year, students have the opportunity to begin their core clinical rotations. These rotations are organized in blocks of that integrate core specialties in at one site for 8 or 12 weeks. Core 1 combines Internal Medicine, Family Medicine, and Geriatrics for 12 weeks, Core II combines Pediatrics and OB/Gyn for 12 weeks, Core 3 combines Neuroscience and Psychiatry for 8 weeks, and Core 4 combines Surgery and Emergent Care for 8 weeks. Each of these clinical rotations is offered at all of the School of Medicine’s hospital.
affiliates including University Hospitals of Cleveland, MetroHealth Medical Center and the Louis Stokes VA Medical Center.

**Longitudinal Clerkship:** Beginning in July 2018, students will have the option of completing their core clinical rotations as part of a 12-month longitudinal clerkship experience at the Cleveland Clinic. The educational learning objectives remain the same for all Case Western Reserve University students on their core rotations, however the structure of this experience will offer some unique features aimed at increased learning, longitudinal experiences with faculty, and creation of a learning community. Students will complete all 40 weeks of their core rotations within the Cleveland Clinic Health System and have 8 weeks of electives that can be taken at other core hospitals in Cleveland or as a visiting student at another institution. The structure of the core rotations will differ from other sites in order to integrate a longitudinal ambulatory block. The rotation structure will be as follows:

- **Longitudinal Ambulatory Block (LAB)** – 12 weeks
- **Team-Based Care 1** – Inpatient Internal Medicine/Surgery – 12 weeks
- **Team-Based Care 2** – OB, Inpatient Gynecology, Inpatient Pediatrics – 8 weeks
- **Team-Based Care 3** – Neurology/Psychiatry – 8 weeks
- **Electives (any site)** – 8 weeks
- **Vacation** – 4 weeks

The LAB will include outpatient components of Family Medicine, Internal Medicine, OB/Gyn, Pediatrics, Emergency Medicine, Palliative Medicine and Geriatrics. LAB will also provide exciting opportunities for students to explore disciplines and possible areas of career interest and establish longitudinal experiences by working a half-day a week with the same preceptor over 12 weeks. The longitudinal clerkship will also allow students to create a community of learning by participating in Longitudinal Learning Groups over the year. Topics such as quality/safety, high value care and palliative medicine will be covered as part of a year-long curriculum.

### 3. Advanced Clinical and Scientific Studies

Advanced clinical and scientific studies provide students with flexible learning opportunities that support ongoing professional development and residency preparation and planning:

- **Two Acting Internships** are required: one in Internal Medicine, Surgery, Pediatrics, or Inpatient Family Medicine, and one in an area of student choice.
- **One Acting Internship** and all electives can potentially be done outside of the CWRU system.
- **Students are encouraged to augment their interest in scholarship through rotations and activities that focus on sciences** basic to medicine as well as clinical rotations.

### Pathways

In addition to our innovative curriculum, students in the University Program have the option of specializing in several longitudinal pathways:

**Urban Health Pathway:**

The Urban Health Pathway is designed to provide selected students with the opportunity to expand their knowledge and skills in caring for patients in an urban setting, and to foster a better understanding of medicine and health in urban communities by aligning students’ engagement, clinical and research goals with the community’s health care needs.

**The Jack, Joseph, and Morton Mandel Wellness and Preventative Care Pathway:**

The mission of this pathway is to provide participants with insight and skills in wellness and health promotion as it relates to the domain of the mind, body, and spirit, social interactions and the community. The vision is to incorporate and advance the promotion of health and wellness at the individual, family, institutional, professional and community levels.

**Humanities Pathway:**

The vision of the Humanities Pathway is to use arts and humanities-based courses and experiences to promote the development of health care professionals who will explore the fundamental questions of what it is to be human and to be a healthcare professional. Students will think critically about the complex interplay among patients, health care professionals and culture. They will develop innovative and informed approaches to health, well-being and quality of life for the patients and communities they serve, while developing resilience and passion to improve the culture of medicine.

### Evaluation and Assessment

Student assessment in the WR2 Curriculum is designed to accomplish three goals:

1. drive the types of conceptual learning and scientific inquiry that are goals for the WR2 Curriculum
2. assess whether students have attained the level of mastery set for each phase of the curriculum
3. prepare students for medical licensure

These three goals are accomplished through multiple assessment methods.

Independent study and inquiry are hallmarks of WR2 through assessment strategies that are formative, focus on the synthesis of concepts, and promote student responsibility for the mastery of skills and material. The following assessments are used in Foundations of Medicine and Health:

1. **Assessment of students’ participation in weekly Case Inquiry (IQ) groups by faculty facilitators, utilizing observable behavior anchors and focusing on contributions to team process and content, critical appraisal skills, and professional behaviors.**
2. **Synthesis Essay Questions (SEQs).** Weekly, formative, open book concept reasoning exercises in which students are given a brief written clinical scenario and asked to explain a clinical phenomenon and its basic science underpinnings. Throughout a teaching block, students complete SEQs at the end of each week. They compare their own answers to an ‘ideal’ answer and receive feedback from their IQ group facilitator.
3. **Summative Synthesis Essay Questions (SSEQs), or exercises that measure what students know at specific points in their education, are closed book exercises with approximately 5 clinical vignettes that take an estimated 3-4 hours to complete. These SSEQs are based on the synthesis essays students have been assigned throughout the block. In the final week of the block SSEQs present concepts from previous exercises in new contexts and require concept integration. These summative exercises are scheduled at the end of each large teaching module (every 3-4 months) and are graded by faculty.**
4. Structure Practical Exercises. These assessments occur in the final week of blocks 2-6 and assess anatomy, histo-pathology and radiology through clinical scenarios and questions that require anatomic localization and histo-pathologic identification.

5. Self-Assessment Multiple Choice Questions (MCQs). Throughout the block students are required to complete MCQs. These are drawn from the School of Medicine’s extensive bank of questions which are mapped to learning objectives for the block. Students use these MCQs throughout the block as a study aid and method of self-assessment.

6. Cumulative Achievement Tests (CAT). At the end of each block, students complete a secure formative MCQ achievement test, based on content covered in the current teaching block as well as on content from each previous block. These exams are designed utilizing test question resources available through the National Board of Medical Examiners (NBME). Tests will become progressively longer throughout the Foundations of Medicine and Health. The final CAT reflects material across all curriculum blocks. These formative tests enable students to gain perspectives on their overall progress and preparedness for the USMLE Step 1.

7. Student progress in Foundations of Clinical Medicine is measured by small group facilitator assessment in the Seminars of Clinical Practice, direct observation of skills, preceptor evaluation of patient-based activities, and OSCE examinations.

8. Professional Learning Plan. During the Block, students review learning objectives and reflect on their learning, identifying their strengths and areas for further study. A reflective essay is completed that links to pieces of evidence, accumulated throughout the block, to support areas of strength and areas for further growth that have been identified. Students, working with their Society Deans develop a plan for further learning.

The WR2 Curriculum provides students with a focused education that is faculty directed and student centered. Classroom hours are limited. The content of WR2, organized across biological systems, provides students with an integrated view of medicine and health and an understanding of how the basic sciences and clinical practice relate to one another. The flexibility of WR2 permits students to explore in depth an area of interest to them alongside a mentor. The curriculum places great emphasis on the social and behavioral context of health and disease as well as on population medicine which will prepare students to face the emerging challenges of today’s health care system.

Assessment for Promotion and Graduation

The faculty of the School of Medicine is charged with assessing student performance, including knowledge, skills and personal characteristics that are important qualities of a responsible, competent and humane physician. This responsibility is delegated by the faculty to the Committee on Students, a standing committee of the faculty of medicine, with a majority of its members faculty-elected.

The Committee on Students reviews the performance of every medical student in the University Program during each of the four years, determines each student’s continuing status as a student in the school, and recommends candidates for graduation. The committee reviews a medical student’s total performance, which includes the usual indices such as formal grades and assessments, as well as the professional attitudes and behavior manifested by the student. Medical education entails the mastery of didactic, theoretical, and technical matters as well as the demonstration of appropriate professional and interpersonal behavior, sensitivity, sense of responsibility and ethics, and the ability to comport oneself suitably with patients, colleagues and co-workers. To be eligible for promotion and graduation, students must complete the requirements and perform satisfactorily in all components of the curriculum. Medical students in the University Program are graded “meets expectations” or “does not meet expectations” in the first two years and as “honors,” “commendable,” “satisfactory,” “unsatisfactory,” or “achieves or exceeds expectations” in the clerkships of the third and fourth years. There is no class ranking.

Graduation Requirements

To graduate from CWRU School of Medicine with the MD degree (or the MD degree with Special Qualifications in Biomedical Research for students in the Cleveland Clinic Lerner College of Medicine program), students must:

1. Satisfactorily complete all Program Specific Requirements and Educational Program Objectives of the School of Medicine
2. Pass the USMLE Step 1 and USMLE Step 2 CK and CS
3. Pass or remediate the School of Medicine’s Clinical Skills Exam
4. Satisfactorily complete the MD Thesis
5. Meet financial obligations to the University
6. Be approved to graduate by the Committee on Students

Overview of the College Program

The Cleveland Clinic Lerner College of Medicine (CCLCM or College Program) is a distinct 5-year program within the School of Medicine. In 2002, Cleveland Clinic and CWRU formed a historic partnership to collaborate in education and research through creation of the CCLCM. As stated in the affiliation agreement between the two institutions, “the principal purpose and educational mission of the College shall be to attract and educate, in specially designed programs, a limited number of highly qualified persons who seek to become physician investigators and scientists who will advance biomedical research and practice.” To achieve this mission, the CCLCM selects students with a desire to pursue careers as physicians and researchers, educates them to be excellent doctors, nurtures their curiosity about science and medicine, provides them with substantive research experience and core research skills, and offers financial support to ensure that excess debt does not preclude their ability to follow careers in research and medicine.

The College Program in Detail

Training the Physician Investigators of Tomorrow: A Synopsis of the Program

Recognizing the critical shortage of physicians engaged in research, the College Program offers an educational program that provides medical students with the necessary skills and knowledge to enter academic residencies and pursue successful careers as basic, translational or clinical investigators and expert doctors – without requiring them to complete an advanced degree in addition to the MD. Graduates are expected to be scientifically inquisitive, to be life-long learners, to be independent thinkers with excellent teamwork skills, to have broad-based research knowledge as well as strong clinical acumen, and to be reflective practitioners of medicine and science who take a critical approach to self-assessment and self-improvement. All three components of the curriculum – basic science, clinical and research – in addition to the advising and assessment processes have been created to support the development of these attributes in our medical students.
The basic science curriculum applies adult learning principles, building on problem-based learning (PBL) to create an early link between clinical problems and basic science learning and to help students develop their skills in hypothesis generation, critical thinking, self-identification of learning objectives, oral presentation and teamwork. Almost all faculty-student contact time involves some form of active learning – graduate school-style seminars and problem sets rather than lectures, case-based anatomy sessions using prosections and cross-sectional images rather than full cadaver dissections, interactive lab sessions rather than demonstrations, and journal clubs. To support this educational model, curriculum schedules provide extensive time for independent study. The basic science curriculum is organ-system based, with the disciplines of anatomy/embryology, biostatistics/epidemiology, cell biology, histology, imaging, immunology, pathology, pharmacology, physiology, infectious disease, oncology, genetics, evidence-based medicine, bioinformatics and ethics designated as curricular threads woven through every organ-based basic science course and extending into the year 3-5 clinical curriculum. Learning objectives for the thread disciplines are used to determine the organ system curriculum structure in the first two years, with the goal of providing a logical, coherent two-year curriculum in each of these topics basic to medicine. Courses in Year 1 focus on normal human structure and function; in Year 2, courses focus on pathophysiology of disease. Later, in Years 3 through 5, students revisit advanced basic science concepts in their core clinical rotations, clinical electives, and College Program specific pullout sessions.

The clinical curriculum begins in the fall of the first year contiguous with the first basic science course in Year 1. At its foundation is a continuity teaching and learning experience with a primary care preceptor and his/her patients throughout the first two years. Students spend one half-day every other week in Year 1 and one half-day every week in Year 2 with the same preceptor. During Year 1, students learn core clinical skills in doctor-patient communications and physical diagnosis in sessions linked whenever possible to the basic science courses (e.g., learning the cardiac and lung exams during the Cardiovascular and Respiratory Sciences course and the basic neurological exam during the Neurological and Behavioral Sciences course) and then practice those skills with real patients in their preceptors’ offices on alternate weeks. Once they have mastered the basics of the history and physical, they begin to apply their skills to more complete evaluations of ambulatory patients with direct observation and feedback from their preceptors. By the end of Year 2, students are capable of performing a complete history and physical and confidently evaluating adults with common outpatient problems.

In Year 2, students spend a second half-day each week in sessions focused on building advanced clinical skills or clinical activities designed to complement concomitant basic science systems topics (e.g., a session in the Diabetes Clinic during the week devoted to learning about diabetes). The other key component of the clinical curriculum in Years 1 and 2 is the weekly Art and Practice of Medicine Seminar series. This course focuses on principles of leadership and their application to medical practice, professionalism and ethics, health care systems, population medicine, and provides a setting for students to reflect on their experiences and observations of the health care system. In Years 3 through 5, students in CCLCM participate in the same core clinical experiences as students in CWRU’s University Program. Friday afternoon sessions in Years 3-5 bring CCLCM students together regardless of clinical location and focus on program-specific topics in research and human values.

During all five years, there are close mentoring and advising relationships between students and faculty. To ensure this happens, at the beginning of medical school each student is assigned a physician advisor who serves as the student’s partner and guide in navigating and mastering the curriculum throughout all five years. In addition, during the first summer, each student is assigned to an experienced basic or translational research preceptor who integrates the student into all activities in his/her lab and provides guidance and feedback to the student in such areas as working effectively with the lab team, research design, data analysis, and oral and written presentations of research. During the second summer, each student develops a similar relationship with an experienced clinical researcher who includes the student as an active participant in one or more ongoing research projects. Students are exposed to a broad range of basic, translational and clinical researchers during the first two years – during the summer research blocks, during weekly research seminars (Advanced Research in Medicine series), and in class during basic science and clinical courses. Students then select a research advisor for the master’s level research project on which they will spend 12 to 15 months during the last three years of medical school.

The College uses a unique approach to student assessment designed to enhance student learning and to promote self-directed learning. There are no grades for any course or rotation, and no class ranking. Instead, each student is expected to attain a defined level of achievement in each of the 9 CWRU School of Medicocompetencies. Seven of these defined competencies encompass the 6 core competencies defined for all U.S. graduate medical education programs accredited by the ACGME (Accreditation Council for Graduate Medical Education) as well as research and personal development. Starting on the first day of medical school, students begin collecting evidence from faculty and peers of their progress in achieving the standards in each of the 9 competencies and reflecting on how the evidence demonstrates their development as doctors and researchers – the two interrelated professional roles for which they are preparing.

One of the principles of the College is that assessment drives learning – that a curriculum designed to foster self-directed learning and achievement of competencies is ineffective if assessment focuses on what the “teacher” said in class and factual recall. Therefore, the College uses a student-centered, student-driven approach to assessment with strong support from the physician advisors who know the students well and guide them as they develop skills and self-confidence as self-directed learners.

Students gather a broad range of types of evidence over their five years of study and work as partners with their physician advisors to review the evidence and their reflections, to create individual learning plans to address areas of relative weakness, and to tailor the curriculum to build on their areas of particular strength. Evidence of achievement and reflections on progress in their professional development are collected in electronic Student Portfolios and used to document readiness for promotion and graduation from the program. By training students in accurate self-assessment and developing their reflective ability, we intend to send them out of medical school already skilled in the kind of independent, self-directed learning habits that will be required of them as residents and throughout the rest of their professional lives.

CCLCM’s Foundation: A Comprehensive Research Curriculum

The research curriculum begins on the first day of medical school with the basic and translational research block and is integrated throughout all five years of the College Program. Every student participates actively in a “bench” project in the first summer, prepares an oral presentation describing the project in the format used at most scientific meetings, and develops a mock research proposal that extends the summer research
of the connection between advances in biomedical research and patient care, and have the opportunity to reflect on their ongoing development as both physicians and researchers.

Curriculum Timeline: Years 1 and 2

Students begin Year 1 with a one week-long Orientation in which they are formally welcomed to the profession of medicine by the Deans and their physician advisors. The week includes individual meetings with the student’s summer research preceptor and physician advisor, an introduction to the unique assessment system and the Student Portfolio, and an introduction to the summer curriculum and its expectations. A White Coat Ceremony that commemorates the entry of all students in both the College and University programs into the CWRU School of Medicine highlights the week.

The Basic and Translational Research Block occupies the first 10 weeks of Year 1 and includes a course reviewing core concepts in cell biology, molecular biology and biochemistry. Scheduled classes and meetings occur 5 days a week for 2 hours, with the remainder of each day devoted to independent study and hands-on experience in the lab of the student’s summer research preceptor. This block sets the stage for active learning in the rest of the curriculum. Throughout the core basic science course and all the basic science courses, each week has a conceptual “theme” within which more detailed learning objectives fall. All assignments and scheduled activities are designed to help students master the core concepts for the week. Mastery is defined as being able to explain the concepts and to apply them to new or different problems or situations, rather than simply “listing” all the factual details. Sessions for the core basic science course are held on Monday, Wednesday and Friday mornings and students are expected to study background material before class and self-assess their understanding of the readings. They then work together in class to solve complex problems related to what they have studied. Tuesday mornings are devoted to focused discussions and presentations related to the science topics discussed that week or introduce students to key concepts in areas such as genetics, oncology, and bioinformatics.

Students meet each Friday for a Journal Club aimed at enhancing skills in critically assessing the basic science research literature. Each week, two students present an article; the other students are expected to read the articles carefully and come prepared with questions. Each presenter works with a faculty facilitator to review the paper and presentation before Journal Club. Using feedback from faculty and other students on their presentations and on the questions they ask of others, students begin to hone their communication skills and develop confidence participating as speakers in this setting.

The primary focus of the Year 1 Basic and Translational Research Block is the summer research project. Students are assigned to a summer research preceptor with attention to individual preferences for specific research areas. They are expected to engage fully in all activities in the preceptor’s research group, such as special lab meetings or journal clubs, in addition to working on their defined project. At the end of week 2, they submit a draft plan for their summer research project and review it with their preceptor to set the expectations for the summer. During the summer, students also develop a brief research proposal that extends their research project. At the end of week 5, they submit a draft outline of their brief research proposal. The final document is due in week 9. During week 10, students present their projects orally in the format used at many scientific meetings – a 10-minute presentation with audiovisuals followed by 5 minutes for questions. Thus, in addition to actually working on a bench project, students are guided by their preceptors in developing a number of other key skills. Students receive
During the summer, students schedule their first formal meeting with their physician advisors to review the evidence in their Student Portfolios, to discuss their reflections on their development in their new professional roles, and to review their learning plans to address any specific weaknesses or gaps they have identified. They review feedback on their activities in small group and journal club, lab work, mock grant proposal, oral presentations and scientific writing. This evidence is provided by their summer preceptors, peers, and self-assessments of their mastery of the core basic science concepts. Just as the interactive learning in class sets the stage for research and the rest of the curriculum, the first summer sets the stage for student success in the unique assessment process used in College Program.

Each week of the Year 1 and 2 basic science courses is organized around a theme that provides a focus of learning for the students and an opportunity to integrate when possible the basic science, clinical, and research curriculum components. For example, the theme of one of the weeks of the Gastrointestinal System 1 course is "Liver, Gallbladder and Pancreas." The Problem-Based Learning (PBL) case focuses on a patient who takes an overdose of acetaminophen and alcohol and subsequently develops liver failure. Students learn normal liver function as they explore this case. (All PBL cases used in the curriculum are based on real cases at the Cleveland Clinic.) The case provides the framework for the anatomy and other seminar sessions that focus on liver, gallbladder and pancreas anatomy, histology, drug elimination, and genetics. Friday Advanced Research in Medicine session is a meeting of the Liver Transplant Selection Committee attended by all the students where research, bioethics, and clinical care are integrated in the discussion of liver transplant candidates. During Years 1 and 2, the topics of the 2 Deans’ Dinners for each class are also coordinated with the basic science course and weekly theme.

The first basic science course in Year 1, Cardiovascular and Respiratory Sciences 1 (CRS1), is a 7-week course in which students learn basic concepts of the normal structure and function of these systems. There are 14 hours of scheduled curricular time each week in the basic science courses, including 6 hours devoted to PBL cases and 8 hours devoted to other activities such as labs, seminars and problem sets.

Throughout Year 1, anatomy, imaging and embryology are integrated into the basic science courses with information presented in two ways — self-directed learning modules that cover basic anatomical information (and are available online), and Case Directed Anatomy Sessions on Monday mornings for which students study clinical cases designed to introduce anatomical concepts and facts before coming to the lab. In the lab, students rotate among a number of stations using cadaver prosections to illustrate the process whereby new biomedical discoveries change clinical practice. Histology is also integrated into the basic science courses, with students using a computer-based virtual microscopy system rather than a mechanical microscope to look at slides. This allows students not only to scan slides but also to see slide annotations and related gross and radiographic images. Specific learning objectives for histology are included in PBL cases in addition to seminars devoted to histology. The goal is for students to understand the gross and histological structures of each organ system in relation to its function, rather than as isolated anatomical facts. For example, during the week in CRS1 devoted to the theme of how the heart functions as a pump, students learn the structure and anatomical relationships of the four chambers of the heart and heart valves and the histological appearance of myocardial cells while they are studying the physiological concepts of preload, afterload and contractility.

In addition to anatomy/embryology, imaging, and histology, the other "threads" in Year 1 include cell biology, pharmacology, physiology, bioinformatics, evidence-based medicine, genetics, nutrition, health care systems, ethics and humanities, building on the core concepts from the summer in specific relation to each organ system. In CRS1, students learn not only the molecular structures and functions of α- and β-receptors but also the pharmacology of endogenous and exogenous agonists and antagonists of these receptors as they study myocardial contractility and physiological regulation of blood pressure. They learn the biochemical pathways involved in aerobic and anaerobic production of ATP as they study determinants of oxygen delivery to myocardial cells, concepts they will revisit and build upon during subsequent courses when they study skeletal muscle metabolism during exercise and the role of the liver in maintenance of normal blood glucose levels. They study physiology of the heart, lungs, red blood cells and plasma as an integrated system providing oxygen and removing carbon dioxide, supporting metabolic needs of the entire body. During each course, students return to the core concepts they mastered in previous courses, using those concepts as a framework for building their understanding of the human organism as a whole. The basic science curriculum continues with Gastrointestinal System (4.5 weeks), Endocrinology and Reproductive Biology (4 weeks), Renal Biology (3 weeks), Musculoskeletal Sciences (3 weeks), Neurosciences (5 weeks), and Hematology, Immunology and Microbiology (7 weeks). Each basic science course focuses on normal structure and function, relating back to previous courses and preparing students for concepts in future courses.

Starting in the fall of Year 1, the Basic and Translational Research Summer Block’s Friday journal clubs are replaced by Advanced Research in Medicine 1, a weekly series of research seminars in which students are exposed to a wide range of basic and clinical research topics in interactive discussions with accomplished investigators. Presentations are linked closely with the basic science curriculum in order to reinforce core basic science concepts, help students feel confident in questioning the investigators based on what they are learning at the time, and illustrate the process whereby new biomedical discoveries change clinical practice.

Foundations of Clinical Medicine begins at the same time as the first basic science course and continues throughout Years 1 and 2. The guiding principle is that early exposure to patients, with direct observation and feedback by experienced faculty physicians, is optimal for real time assessment and feedback of student clinical skills. Foundations of Clinical Medicine has 3 interrelated components — clinical skills training, patient care experiences, and Art and Practice of Medicine seminar series. The Art and Practice of Medicine seminar series is a two-year continuum addressing professionalism, ethics, leadership and its application to the care of patients and the practice of medicine, evidence-based medicine, health care systems and patient safety introduced to students primarily through the humanities.

Core clinical skills training occurs every other week from September through May and is coordinated with the organ systems under study. On alternate weeks, students practice the basic skills they just learned with standardized patients in the classroom by conducting histories and physical exams with real patients and writing chart notes on the
previous week under the supervision of their longitudinal preceptors. Starting in February, students are exposed to special aspects of the history and physical for geriatric and pediatric patients, while continuing to work on basic skills every other week with their preceptors. They also begin to take on more patient care responsibility in preparation for their weekly clinics with the same preceptor in Year 2. An Objective Structured Clinical Examination (OSCE) with feedback from preceptors is used to help students chart their progress in mastering core skills.

Year 2 begins with the 9-week Clinical Research Block. Students work with a preceptor in an active clinical research environment on an ongoing project, continuing to develop their skills in building relationships with members of a research team. They also write a mock clinical research proposal that extends the research question on which the student is working during the summer. Scheduled coursework occupies 2 hours each weekday and includes a rigorous immersion in biostatistics with students using statistical software to analyze real data sets and a clinical epidemiology course focusing on formulation of scientific questions, study design, clinical trials, and legal and ethical issues in research including human subjects’ protection. The coursework requires significant class preparation for students, thus students must balance their time and effort between the classwork and research project in the Year 2 summer. Journal Club sessions on Fridays focus on articles from the clinical research literature, with students using knowledge gained from biostatistics and epidemiology to help them analyze the papers. Feedback from peers and faculty facilitators help students enhance their presentation skills and ability to critically read and present scientific papers. Students complete the second summer with a comprehensive range of clinical research skills and knowledge, complementing their basic research experience in the first summer and preparing them to engage in basic, translational or clinically oriented research for their thesis.

For the remainder of Year 2, students return to the same organ-system based basic science curriculum they studied in Year 1, this time focusing on learning the pathophysiology of common diseases. Immunology, Pathology, Oncology, Infectious Disease/Microbiology, and Biostatistics/Epidemiology are now integrated as threads throughout the Year 2 basic science curriculum. The first basic science course is Musculoskeletal Sciences (2 weeks), followed by Neurosciences (3 weeks) and Behavioral Sciences (3 weeks), Endocrinology and Reproductive Biology (4.5 weeks), Cardiovascular and Respiratory Sciences (7 weeks), Hematology (4 weeks), Gastrointestinal System (4 weeks), and Renal Biology (4 weeks). Anatomy and embryology seminars are conducted less often during Year 2, usually 1–3 sessions per course. The clinical curriculum continues to be closely linked to the basic science courses. Students spend one half-day every week in their primary care longitudinal preceptor’s office. An additional clinical half-day is added and students see patients who demonstrate the pathophysiology being studied that week. Some of the additional half-days are devoted to learning advanced clinical skills (the gynecologic and urologic exams, evaluation of geriatric and pediatric patients with common problems) and an exposure near the end of Year 2 to the acute care setting helps to prepare students for Year 3. The Art and Practice of Medicine seminar series begin in September of Year 1 and ends in April of Year 2. Students also participate in two OSCEs, one at the beginning of Year 2 to help students identify skills to address over the year and the second at the end of Year 2 to help students document their skills for portfolio. After classes end in mid-May, students have 6 weeks available to study for and take the USMLE Step 1 Examination.

By the end of Year 2, students have engaged actively in both basic and clinical research, learned and practiced a wide range of research skills. They have extensive experience in self-directed learning both independently and in teams and have mastered core basic science concepts related to human health and disease. They are comfortable “doctoring” adult outpatients and competent in the complete history, physical examination, oral and written presentations, and basic clinical skills such as reading EKGs. Perhaps most important, they have learned to accurately assess their own strengths and weaknesses and create learning plans for themselves – preparing them to succeed in the next three years of the curriculum and a lifetime of professional practice.

Curriculum Timeline: Years 3 through 5
After Year 2, the clinical curriculum for the College Program is the same as the University Program. In all Core Clinical Rotations, students experience both breadth and depth in clinical care, and clinical experiences are developmental, with opportunities to reinforce, build upon, and transfer knowledge and skills. Clinical learning is also integrated across disciplines whenever possible, and the roles of basic science, civic professionalism, scholarship, and population health in clinical care are evident throughout the clinical curriculum. Students likewise have patient care responsibilities that are progressive in sophistication and increasing in amount as their level of clinical skill and knowledge increases, and all core clinical competencies are addressed and assessed using common methods applied at the clinical sites at which rotations occur.

Core Rotations: Beginning in July of their third year, students have the opportunity to begin their core clinical rotations. These rotations are organized in blocks that integrate core specialties at one site for 8 or 12 weeks. Core 1 combines Family Medicine, Internal Medicine and Geriatrics for 12 weeks, Core 2 combines Pediatrics and OB/Gyn for 12 weeks, Core 3 combines Neurology and Psychiatry for 8 weeks, and Core 4 combines Surgery and Undifferentiated Care for 8 weeks. Each of these clinical rotations is offered at all of the School of Medicine’s hospital affiliates (including University Hospitals of Cleveland, the Cleveland Clinic, MetroHealth Medical Center and the Louis Stokes VA Medical Center).

These Core Clinical Rotations, launched in July 2006 and modified in 2009 and 2012, represent an integrated approach to clinical education that is shared by students from both the University and College programs of the School of Medicine. Students engage in clinical learning with basic science correlation through patient-based experiences that are developmental and provide opportunities to acquire, reinforce, build upon, and transfer knowledge and skills.

Advanced Clinical and Scientific Studies
Advanced clinical and scientific studies provide students with flexible learning opportunities that support ongoing professional development and residency preparation and planning:

- Two Acting Internships are required: one in Internal Medicine, Surgery, Pediatrics, or Inpatient Family Medicine, and one in an area of student choice.
- One Acting Internship and all electives can potentially be done outside of the CWRU system.
- Students are encouraged to augment their interest in scholarship through rotations and activities that focus on sciences basic to medicine as well as clinical rotations.

The last three years are purposely designed as a flexible continuum of core clinical rotations, clinical and other electives, and research – to allow each student to individualize the curriculum to address his/her own career goals, learning needs and research interests. Each student plans
the last three years with the advice of his/her physician and research advisors.

Every CWRU student must pass the CWRU Clinical Skills Examination and USMLE Step 2 CK (Clinical Knowledge) and CS (Clinical Skills) Examinations to graduate from the CWRU School of Medicine. Students take OSCEs similar in format and content to the USMLE Step 2 CS Examination as part of routine assessments of their clinical skills beginning in Year 1 and are well prepared for the CWRU Clinical Skills Examination and USMLE Step 2 CS Examination by the time they have completed the required clinical rotations. Students must take the USMLE Step 2 CK and CS Examinations by October 31 of their 5th year.

Students spend 12 to 15 months during the last three years on their mentored research project, including preparation and defense of a masters’ level thesis. Students are expected to complete their research in one block of time. During time devoted primarily to research, students spend one half-day each week in related clinical activities. Students must complete all required research rotation by December 31 of Year 5 and defend the Research Thesis within 3 months of research completion, but no later than February 15 of Year 5. Within these guidelines, students and their advisors are encouraged to be as creative as possible in designing the final 3-year continuum. Research may be conducted with faculty research advisors at any CWRU campus, or in some instances, with advisors at a limited number of other institutions (e.g., the NIH), with advanced approval from the Research Education Committee. Student research may focus on clinical, translational or basic research. Some students may wish to engage in health services research, research in biomedical ethics, or other areas relevant to the advancement of biomedical science and the care of patients in addition to the more “traditional” research areas.

**The Student Portfolio: Competency-Based Assessment and Reflective Practice**

The College’s approach to student assessment is based on two key educational concepts — “competency-based assessment” and “reflective practice.” Competency-based assessment emphasizes the need for every student to achieve the broad range of required learning outcomes by providing an appropriate curriculum, learning resources, and regular formative assessments. No grades are assigned in the College Program during the 5 year program; when a student achieves the standards for all competencies, they are assigned a “Achieves Expectations” (“AE”) for each course on their transcript. Assessment of student performance is criterion-referenced, not norm-referenced; students are not compared to one another but to faculty-defined standards of achievement. A full range of assessment methods are used to profile learning outcomes. Reflective practice emphasizes that learning is dependent upon the integration of reflection and experience. Professionals learn by reflecting on their experiences both during the experiences (“reflection-in-action”) and after the experiences (“reflection-on-action”) and by using these reflections to develop new knowledge and skills. The assessment process helps our students develop their reflective practice skills – the ability to accurately describe, analyze and evaluate their performance and to identify and follow through on effective learning plans. We are committed to helping every student achieve our competency standards and develop reflective practice skills through frequent formative assessments and close advising.

Evidence of achievement for each of the Case Western Reserve University School of Medicine’s Program’s 9 competencies is collected and managed in an electronic portfolio. Students and their advisors share access to the e-Portfolio database of evidence and thus can track and document student progress in meeting our nine competencies. A broad range of types of evidence is collected from the learning experiences in the research, basic science, and clinical curriculum.

During research blocks, research preceptors, journal club facilitators, problem solving session facilitators, and student peers provide written assessments of both individual work and teamwork in the lab, written and oral presentations, and critical thinking and reasoning skills. Written research proposals and reports and the final thesis are also included in the e-Portfolio.

During the basic science courses, students complete weekly online quizzes called **Self-Assessment Questions (SAQs)** that test the breadth of knowledge for each week’s theme at the level of factual recall and simple application of the facts. Faculty design the SAQs so that students who are actively participating and studying should expect to know at least 80% of the answers; the individual results of the SAQs are available only to the students, but students are encouraged to contact the course director for help with any difficulties they are having. Students have continued access to the SAQs to assess their retention of this basic science knowledge. At the end of each week, students complete 1-2 open book **Concept Appraisals (CAPPs)** designed to determine if they have mastered the concepts for that week well enough to apply them to new or different problems or situations in brief, well-organized, clearly written essay(s). CAPPs are designed to assess depth of knowledge in key concept areas. Other evidence is provided by PBL facilitators and peers who provide assessments of performance in PBL sessions.

Assessments in the clinical curriculum include written feedback on performance from longitudinal preceptors and other faculty physicians and residents, results of OSCEs, patient logs documenting breadth of clinical exposure, patient journals in which students record their reflections on specific patients and their problems, self-assessments of videotaped interviews with patients (both standardized and real), and feedback from patients and other health care providers.

Students are expected to meet regularly with their physician advisor to discuss their progress. Several times each year, they are required to review their assessment evidence in relation to expected levels of achievement in the 9 competencies and write Formative Portfolios composed of structured reflective essays on how the evidence demonstrates their development as doctors and researchers. Based on this analysis, they develop learning plans to address areas needing improvement. The essays also include judgments on whether previously established learning goals have been achieved and reflections on the process of achieving these goals. Students discuss these materials with their physician advisors during Formative Assessment meetings. During the last three years, students submit learning plans on a bi-annual basis, and meet with their physician advisor to review their progress. Students are expected to assume more and more responsibility and independence in accurate self-assessment, in developing learning plans and following through on addressing their own learning needs, and in recognizing and building on their own strengths.

At the end of Years 1, 2 and 4, students assemble a Summative Portfolio for review by the Medical Student Promotions and Review Committee that determines if the evidence presented by the student indicates a level of achievement sufficient for promotion to the next year of the program (or graduation). Students are expected to choose not only their best examples of their work, but more importantly evidence demonstrating their growth across the year in specific competencies. We want to graduate students who recognize areas needing improvement, identify an approach to addressing them, and can show that they have now achieved
that skill as well as those students who excel in specific areas throughout the year. Graduates of CCLCM will have not only achieved a defined level of achievement of each of the 9 competencies, they will also have developed their reflective ability to accurately assess their own strengths and areas needing improvement. The assessment process is designed to enhance student learning and the student portfolio enables students to document their progress in the achievement of defined competencies.

Graduation Requirements

To graduate from CWRU School of Medicine with the MD degree (or the MD degree with Special Qualifications in Biomedical Research for students in the Cleveland Clinic Lerner College of Medicine program), students must:

1. Satisfactorily complete all Program Specific Requirements and Educational Program Objectives of the School of Medicine
2. Pass the USMLE Step 1 and USMLE Step 2 CK and CS
3. Pass or remediate the School of Medicine’s Clinical Skills Exam
4. Satisfactorily complete the MD Thesis
5. Meet financial obligations to the University
6. Be approved to graduate by the Committee on Students

Dual Degree Programs

Dual Degree Programs with the MD

The degree programs listed in this section may require admission to another school at the university in addition to or instead of the School of Medicine. Each school may have different deadlines and requirements for admissions. Please contact the other schools separately using information provided under that school's listing in this publication. Additional dual degree programs not including the MD are also offered through the medical school’s departments. Several certificate programs are also offered in General Medical Sciences

MD/PhD (MSTP)

The Medical Scientist Training Program (http://mstp.case.edu/default.asp) leading to the MD/PhD in various biomedical programs is listed in above grey tab.

Doctor of Medicine- MD/JD

This program, offered in conjunction with Case Western Reserve University School of Law, may be completed in six years. The JD portion requires the completion of 88 credit hours of study. Admission is through the School of Medicine and the School of Law. For more information about the JD portion of the program, visit the Law School section (p. 674), call the law school admissions office at 216.368.3600 or 800.756.0036, or e-mail lawadmissions@case.edu (//lawadmissions@case.edu).

Master of Arts in Bioethics- MD/MA

The 27-credit-hour Master’s degree program, including a 12-hour foundations course taken during the first year of medical school, provides advanced training in bioethics while emphasizing the interdisciplinary and interprofessional nature of the field. In this program, medical students will participate in and contribute to the critical analysis of moral issues related to health, health care, and health policy at local, national and international levels. Medical school students complete the bioethics program while pursuing their medical degrees; no additional time is required. Admission for the master’s degree portion is through the Case Western Reserve University School of Graduate Studies.

For more information about the MA requirements, visit the Bioethics section (p. 749), call 216.368.8718, or e-mail bioethics@case.edu (//bioethics@case.edu).

Master of Public Health- MD/MPH

Graduates of this 5-year, 36-hour master’s degree program are qualified to work in local and state health departments, universities and colleges, hospitals, ambulatory medical centers, non-profit organizations and the insurance and pharmaceutical industries. Areas of concentration include adolescent health, health promotion and disease prevention, epidemiology, public health research, health management and policy, clinical research, international health, human sexuality and reproductive health, and urban health. For more information about the MPH requirements, visit the Master of Public Health website (http://mph.case.edu), call 216.368.3128, or email info@casemph.org.

Master of Science in Applied Anatomy- MD/MS

Students seeking advanced training in the anatomical sciences may begin the 30-hour master’s degree program in the fall or spring semester of the first year of medical school. Required graduate courses include the anatomical sciences core curriculum, completed during the first two years of medical school, and an advanced surgical anatomy course taken in the fourth year. Students earn the remaining credits through elective courses. Completion of a thesis is not required, but students may undertake independent research experiences as electives; a thesis-based program also is available. Interested medical students must apply to the master’s program through the Department of Anatomy. The program is excellent preparation for those preparing for biomedical careers or those planning to pursue a PhD. Additional details and a sample course of study are described in the Anatomy section (p. 732) of the General Bulletin. For more information about the MS requirements, visit the Master of Science in Applied Anatomy website (https://case.edu/medicine/anatomy/education/ms), call 216.368.2433, or email anatomy@case.edu.

Master of Science in Biomedical Engineering- MD/MS

Medicine is undergoing a transformation based on the rapid advances in science and technology that are combining to produce more accurate diagnoses, more effective treatments with fewer side effects, and improved ability to prevent disease. The goal of the MD/MS in Engineering is to prepare medical graduates to be leaders in the development and clinical deployment of this technology and to partner with others in technology based translational research teams. Current CWRU medical students in either the University Program (UP) or the Cleveland Clinic Lerner College of Medicine (CCLCM) may apply to the MD/MS in Engineering program.

Students must complete the normal requirements in either MD program. Portions of the medical school curriculum earn graded credit toward the MD/MS degree. Six credit hours can be applied to the MS component of the joint degree. The balance of 12 credit hours (4 courses) must be graduate level engineering concentration courses that provide rigor and depth in a field of engineering relevant to the area of research. All students attend monthly seminars focusing on the integration of engineering and medicine, with the opportunity to present their own research and to hear and interact with other presenters. Students must also complete training in the responsible conduct of research.
The thesis serves a key integration role for the joint degree, with both medical and engineering components. The thesis also fulfills the research requirement of the UP or CCLCM programs. Students should apply through the BME department admissions office. For more information about the MS requirements, visit the Biomedical Engineering website (http://engineering.case.edu/ebme), call 216.368.4063, or email bmedept@case.edu.

**Master of Science in Biomedical Investigation- MD/MS**

This five-year dual degree program is designed for students who wish to prepare for careers in basic or clinical research at academic medical centers. The core components of this degree are three to six graduate courses in a specific track chosen by the student based on his or her interest, six graded credits of medical school coursework, a common seminar series, training in scientific integrity, and a full-year research project culminating in a written report and examination by faculty. Tracks include biochemistry, clinical investigation, epidemiology, health services research, nutrition, pathology, and physiology and biotechnology. Each track has specific course requirements. There is no tuition charge for the research year, and a stipend is provided. For more information visit the Biomedical Investigation website (https://case.edu/medicine/admissions/programs/dual-degree/biomedical-investigation), or contact the College Program Advisor, Dr. Chris Moravec (MORAVEC@ccf.org) or the University Program Advisor, Dr. William Merrick (william.c.merrick@case.edu).

**Master of Business Administration- MD/MBA**

There is a growing need for physicians with business skills to manage organizations such as corporate practices, hospitals, etc. Those who complete this 5-year program will be able to apply learned management principles and take leadership roles as they navigate through varying and increasingly complex healthcare environments. For more information about the MBA requirements, visit the Weatherhead School of Management website (https://weatherhead.case.edu/degrees/masters/dual-degree/md-mba), call 216.368.2030, or email casemed-admissions@case.edu.

**Master of Anthropology- MD/MA**

This 4-year dual degree program is an organized course of study for students with a range of medical anthropological interests, from ethnomedicine to international health, urban health, psychiatric anthropology, psychological anthropology, cross-cultural aging, human adaptation and disease, nutritional anthropology, etc. The program is designed for students who wish to pursue anthropology beyond the baccalaureate level and to become acquainted with professional work in anthropology and to meet the challenges of our increasingly globalized world. For more information about the MA requirements, visit the Department of (http://mph.case.edu) Anthropology (http://anthropology.case.edu/graduate-programs/joint-programs/mdma-ormdphd) website (http://mph.case.edu), call 216.368.2264, or email the Department Administrator, L (info@casemph.org) linda rinella (linda.rinella@case.edu).

**Medical Scientist Training Program (MSTP)**

A combined MD/PhD program in biomedical sciences, the Medical Scientist Training Program (MSTP) is available for students desiring research careers in medicine and related biosciences. This program takes seven to eight years to complete, depending on the time needed to complete the PhD dissertation research. Financial support includes a stipend and full tuition support.

Candidates must meet established prerequisites for admission to both the School of Medicine and the School of Graduate Studies. Criteria include demonstrated capabilities in research and superior undergraduate academic credentials. Applicants must have either U.S. citizenship or permanent residency status to be considered for admission to the MSTP. Information can be obtained by contacting the MSTP program (mstp@case.edu) or from the program website (http://mstp.case.edu). Admissions are coordinated by the School of Medicine admissions program and the AMCAS application.

The first two years of the MSTP are centered on the University Program pre-clinical core medical school curriculum, which occupies five mornings each week. Afternoons include time for graduate courses and/or research rotations, as well as clinical training, thus integrating the medical school and graduate school experiences. The next three to four years are devoted to completion of graduate courses and PhD thesis research in one of the multiple MSTP-affiliated graduate programs. During the PhD phase, MSTP students participate in the MSTP Clinical Tutorial, a program designed to enhance clinical skills and allow students to develop connections between their research and clinical interests (this further addresses the goal of integrating medicine and science). After completion of the PhD program, students return to medical school for two years to complete clinical clerkships and finish the MD curriculum.

The program is administered by the MSTP Steering Committee, which consists of faculty from both basic science and clinical departments. Its functions include selecting candidates for admission, designing and administering the program curriculum, advising students and evaluating student progress.

Please see the Doctor of Medicine (MD) (p. 712) page for information about the MD curriculum.

**MSTP Program by Year**

**Year 1**

- University Program MD curriculum
- Summer Intro to MSTP course
- One graduate course or research rotation each semester (fall and spring)

**Year 2**

- University Program MD curriculum
- Summer research rotations (1 or 2)
- Graduate course or research rotation in the fall semester

**Year 3**
Dual Degree Programs

- PhD program

Year 4
- PhD program
- MSTP Clinical Tutorial

Year 5
- PhD program
- Optional MSTP Clinical Tutorial

Year 6 (If Needed)
- PhD program
- Optional MSTP Clinical Tutorial
- All PhD work, including dissertation defense and publications, to be completed before starting the 3rd year medical curriculum

Year 7
- Third year MD curriculum (core clinical clerkships)

Year 8
- Fourth year MD curriculum (completion of core clinical clerkships if necessary, clinical and research electives)

The Medical Scientist Training Program in detail

General Description
The Case Medical Scientist Training Program (MSTP) provides training for future physician-scientists by integrating well-developed curricula in science and medicine. Unique aspects of the program include the integration of graduate school and medical school in many phases of the program to optimize dual-degree training, and a high degree of student involvement in running the program.

The MSTP includes three major phases of training.

First phase: During the first two years, each student completes the first two years of the University Program medical school curriculum, including early clinical experiences, completes at least three research rotations, takes graduate courses, and chooses his or her PhD graduate program and thesis lab. During the summer between the first two years of medical school, students complete one or two research rotations. During the fall and spring semesters of year one and the fall semester of year two, students take a graduate course or complete a research rotation.

Second phase: During the PhD phase, students complete all requirements of their PhD program. They also participate in the MSTP Clinical Tutorial for at least one year in a patient-based clinical specialty. A second year of MSTP Clinical Tutorial is optional.

Third phase: In the final phase, students complete years three and four of the University Program medical school curriculum. The focus is clinical training, but research electives can be taken for part of year four.

Although each of these three phases has a different focus, opportunities exist for students to pursue both research and clinical training in each phase. The philosophy of the Case MSTP is to integrate medicine and science throughout the program as much as possible.

The Case MSTP is run by faculty, students and staff. The MSTP Council is a body of students that plans and runs certain aspects of the program. The administrative director, program coordinator, and program assistant have many important roles and run the day-to-day management of the program. The co-director is involved in decisions at all levels of the program and is the primary advisor for students in the first two years of the program. The director is responsible for all aspects of the program and is available to students for advice at any stage. The MSTP Steering Committee makes decisions on MSTP policy, curriculum planning, student admissions, approval of mentors and evaluation of students.

Incoming MSTP students are expected to enter the program on July 1. The MSTP summer retreat, usually held in early July, provides an important orientation to the program and includes sessions and workshops for program and professional development.

Advising System
The program director provides advising to students in all phases of the program. The MSTP co-director advises students in the first two years on research rotations and course work. Students may also meet with an MSTP Steering Committee member representing an area of research interest or with the MSTP director. During the PhD training period, mentoring is provided by the thesis advisor and thesis committee, which includes a member of the MSTP Steering Committee and a member with an MD. MSTP students are full members of the medical school class and enter one of the four societies of the University Program when they matriculate in the program. The society dean provides important advice for matters concerning the MD curriculum.

Classes and Research Rotations in Years One and Two

Plan of Study

First Year

<table>
<thead>
<tr>
<th>Course/Program</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated Biological Sciences I (IBIS 401)</td>
<td>1 - 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Science I (IBIS 411)</td>
<td>2</td>
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<tr>
<td>Research Rotation in Medical Scientist Training Program (MSP 400)</td>
<td>0 - 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrated Biological Sciences II (IBIS 402)</td>
<td>1 - 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Science II (IBIS 412)</td>
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<tr>
<td>Research Rotation in Medical Scientist Training Program (MSP 400)</td>
<td>0 - 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to MSTP (MSP 401)</td>
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<td></td>
<td>0</td>
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<tr>
<td>Year Total:</td>
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<td>3-20</td>
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</table>

Second Year

<table>
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<tr>
<th>Course/Program</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated Biological Sciences III (IBIS 403)</td>
<td>1 - 9</td>
<td></td>
</tr>
<tr>
<td>Clinical Science III (IBIS 413)</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
The PhD Phase

After completion of the second year of medical school, each student chooses a PhD thesis mentor, joins a specific PhD program, and completes any remaining graduate school course work and other requirements for the PhD degree. The following training programs are affiliated with the MSTP. (If the training program is not itself an independent PhD program, the program through which it is offered is indicated in parentheses.)

- Biochemistry
- Biomedical Engineering
- Cancer Biology (Pathology)
- Cell Biology
- Clinical Translational Science
- Epidemiology and Biostatistics
- Genetics and Genome Sciences
- Immunology (Pathology)
- Molecular Biology and Microbiology
- Molecular Virology
- Neurosciences
- Nutrition
- Pathology (Molecular and Cellular Basis of Disease)
- Pharmacology
- Physiology and Biophysics
- Structural Biology and Biophysics
- Systems Biology and Bioinformatics

All MSTP students are required to take a one-week responsible conduct of research (RCR) course (IBMS 500 On Being a Professional Scientist: The Responsible Conduct of Research) during the spring semester of their second year in the program.

Clinical Tutorial, Clinical Refresher Course and Years Three and Four of Medical School

During the PhD thesis phase, MSTP students take the MSTP Clinical Tutorial, which provides a unique longitudinal part-time clinical experience. The MSTP Clinical Tutorial is a year-long course that enhances clinical skills for year three of medical school. It also serves a special career development objective by allowing students to balance medical and scientific interests and explore the connections between these areas. The MSTP Clinical Tutorial, offered during the PhD phase, is an example of the integration of science and medicine in the Case MSTP. An optional MSTP Clinical Refresher course may be taken before the start of year three. After completion of the PhD, MSTP students are enrolled in medical school to complete the requirements for the MD (see description provided for the University Program (p. 714)).

MSTP Activities

The MSTP supports several activities that enhance the scientific and professional development of students. These activities also foster a vibrant and collegial MSTP community with a strong sense of mission in the training of physician scientists.

Summer retreat: The annual MSTP summer retreat is a two-day event focusing on scientific presentations, professional development and program planning for the upcoming academic year.

Winter retreat: This is a one-day retreat on campus, usually in early March. Students in their research years present their thesis work through an oral or poster presentation.

MSTP Council coordinates many activities of the Case MSTP. The Council meets once each month to discuss activities that are run by different student committees. The overall goals of the MSTP Council are to identify objectives for the program, to allow students to initiate programs to enhance the MSTP, to encourage increased student involvement in the operation of the MSTP, and to enhance development of leadership skills of MSTP students. The president, vice president and secretary are all elected for a one-year period. Committees are led by 1-3 committee chairs who take charge of committee activities and coordinate the involvement of other students in the committee activities. All students are welcome and encouraged to participate in the various committees and to attend the council meetings. Recent Council committees and other program activities have included the following:

1. Monthly Dinner Meeting Committee

This committee is responsible for planning monthly dinner meetings, selecting topics, speakers, and menus. The series is organized by students and is attended by students, Steering Committee members and research mentors. Invited speakers (students, faculty, alumni and outside speakers) address issues pertinent to research, professional issues, career development or other topics of interest. The informal environment at these gatherings promotes social and professional interactions.

2. Communications and Webpage Committee
This committee organizes communications and the Case MSTP website content.

3. **Summer Retreat Committee**
This committee plans the summer retreat.

4. **Intro to MSTP**
This committee organizes events for first year MSTP students, to integrate them into the program and the community.

5. **Community Service Committee**
Plans events for involvement of MSTP students in community service.

6. **Social Committee**
This important committee plans fun events throughout the year!

7. **Student Representative to Faculty Council**
One student is selected to represent the MSTP on Faculty Council.

8. **Student Representative to the Committee on Medical Education**

9. **Representative to the Graduate Student Senate**

10. **MSTP Women’s Committee**
Women in the MSTP organize luncheons or other meetings to discuss issues that face women pursuing careers in science. Students may invite a successful woman scientist who provides a role model as a physician scientist.

**Scientific meetings**: The program strongly encourages students to present their research at national or international meetings and provides financial support to pay for part of meeting travel expenses (other funding is obtained from the research mentor). In addition to the general meeting support for all students, each year two students are offered the opportunity to attend the annual MD/PhD national student conference in Colorado or the American Physician Scientist Association annual meeting in Chicago, with all expenses paid by the MSTP.

**Research symposia**: MSTP students are encouraged to present their research at Case student symposia, including the annual graduate student symposium and the Irwin H. Lepow Student Research Day. These symposia feature a nationally recognized keynote speaker, and students have the opportunity to interact extensively with the noted scientist. A committee awards prizes for outstanding student presentations.

Assessment of MSTP Students

Students in the MSTP are assessed for the medical school component of the program in the same manner as students in the University Program, with the exception that grades are awarded for those courses in the MD curriculum in years one and two that receive graduate school credit and are used to satisfy requirements for the PhD degree. Students must satisfactorily complete all requirements for both the MD and the PhD.

**IBIS Courses**

**IBIS 401. Integrated Biological Sciences I. 1 - 9 Units.**
A four-semester sequence encompassing anatomy, biochemistry, physiology, pharmacology, pathology, and microbiology.

**IBIS 402. Integrated Biological Sciences II. 1 - 9 Units.**
A continuation of IBIS 401.
MSTP 401. Introduction to MSTP. 0 Unit.

Focus and Scope of Course: The course examines the unique challenges that MSTP students face as they navigate a dual degree program. The course will explore strategies that successful MSTP students employ, including mentor choice, time management, strategy and networking. The course will also offer exposure to the various resources available at CWRU for medical and graduate students. Lastly, through journal clubs and formal lecturing, the critical thinking required of an MSTP student will be explored. Objectives: Students will be able to - Employ successful strategies for research rotation set-up and mentor choice - Enunciate strategies for the reconciliation of dual career training with an emphasis on networking, granting and timing - Employ the critical thinking required for manuscript critique and employ successful strategies in both oral and written presentation. Required Texts: None, however, manuscripts may be assigned and will be provided in pdf format. Format and Expectations: As the class is meant to be in dialogue format, meaningful class participation is expected and required. An individual cannot participate if he or she is absent, therefore, attendance is required. If there is a conflict with a required medical school assignment or activity, the medical school activity takes precedence, and attendance in the MSTP course will be waived for that session. Individual students will at times be assigned responsibility for leading the discussion relevant to specified readings. It is expected that all students will complete the readings and assignments prior to the start of the class at which the reading was assigned. Grading: Grading will be Pass/Fail. If students are present at all sessions (excepting when required for an alternative activity at the medical school and excepting excused absences with permission from the instructor), and if the student makes an attempt at a meaningful contribution to the discussion, it is anticipated that all students will pass.

Graduate Programs in the Biomedical Sciences

Graduate Education Office, School of Medicine, RM TG-1
casemed.case.edu/gradprog
Phone: 216.368.5655; Fax: 216.368.0795
Paul N. MacDonald, PhD, Associate Dean for Graduate Education
paul.macdonald@case.edu
Malana Bey (malana.bey@case.edu), Administrator
216.368.5655

The School of Medicine is proud to administer doctoral, master’s, professional and certificate graduate programs in the biomedical sciences, described fully in this bulletin under their departmental or center affiliations. The Graduate Education Office provides support and information on the graduate and postdoctoral training programs in the School of Medicine, as well as professional skill development and training grant proposal support. Resources for proposal development as well as current training information are available at the SOM Graduate Education (http://casemed.case.edu/gradprog) website.

Case Western Reserve University School of Medicine has a strong commitment to the importance of diversity in its research and educational programs. The CWRU community celebrates how our individual diversity in race, ethnicity, gender, country of origin, sexual orientation or gender identity enhances our work together. CWRU programs welcome diverse individuals, including those individuals of racial and ethnic groups underrepresented in biomedical science, those with physical disabilities, and those with disadvantaged backgrounds.

Common Academic Requirements

Each graduate program follows the overall regulations established and described in Graduate Studies Academic Requirements pages (p. 1045) and documented to the Regents of the State of Ohio. In particular, students and faculty are directed to sections regarding Academic Requirements for Master’s and Doctoral Degrees regarding total and graded course requirements, dissertation advisory committees, maintenance of quality-point average, and other general aspects of graduate study at CWRU. Within those overall expectations, a specific course of study for each graduate program is required and described in each degree plan of study.

Guiding Principles for Graduate Education in the School of Medicine

Training and educating graduate students in the biomedical sciences is a complex process that continually evolves based on the rapid progression of scientific discovery and ever expanding technological landscape. Graduate programs must continually modify their approaches to meet these modern-day needs. Students are expected to master their overall discipline, become experts in their field of research, as well as gain expertise in a diverse, but interrelated professional skill set. That skill set should be clearly defined, widely communicated and integrated across all PhD disciplines at CWRU SOM. Moreover, a set of common principles or goals for educating all graduate students in the SOM helps to guide our programs in course or curriculum development. The School of Medicine Graduate Education Office, in collaboration with the graduate program directors, developed a formal set of Guiding Principles (http://bulletin.case.edu/schoolofmedicine/graduateprograms/Guiding_Principles.pdf) for the education and training of all Ph.D. students in order to help accomplish these important goals.

Graduate Admissions to School of Medicine Programs

Graduate students are admitted to our programs through several streams, including the Biomedical Sciences Training Program (http://www.case.edu/med/BSTP), the Medical Scientist Training Program (http://mstp.cwru.edu), dual-degree initiatives, and direct admission to specific programs (please see individual program entries under their affiliated department pages). Postdoctoral Fellows and Postdoctoral Scholars are appointed through the Office of Postdoctoral Affairs (http://postdoc.case.edu).

Student Affinity Groups

Graduate students interact in vibrant groups in the School of Medicine including the Biomedical Graduate Student Organization (http://casemed.case.edu/gradprog/bgso.cfm) and the Minority Graduate Student Organization (http://casemed.case.edu/gradprog/mgso.cfm), as well as university-wide student organizations such as the Graduate Student Council (http://gsc.case.edu). In addition, doctoral students in the School of Medicine organize the annual Biomedical Graduate Student Symposium.

Professional Development

The Graduate Education Office provides professional development opportunities for trainees including the monthly Career Opportunities for Trainees & Professional Enrichment for Trainees Series (http://casemed.case.edu/gradprog/gradprodev.cfm), Pre-Professional Health Program Series, Enhancing Research and Industry Career Horizons (EnRICH) internship and career exposure program (http://casemed.case.edu/gradprog/EnRICH.php), and the Expanding
Teaching Experiences for Doctoral Students (ExTEnD) program (http://gradstudies.case.edu/gradprog/prodevteaching.cfm).

Biomedical Sciences Training Program (BSTP)

Phone: 216.368.3347
http://www.case.edu/med/BSTP/
George Dubyak, PhD (gxd3@case.edu), Director
Debbie Noureddine (dm2@case.edu), Coordinator

The Biomedical Sciences Training Program (BSTP) offers a common admission portal to most biomedical PhD degree programs at CWRU School of Medicine. The BSTP includes eleven doctoral programs in the School of Medicine with more than 200 faculty based in both basic science and clinical departments, giving BSTP students a tremendous range of research opportunities in many disciplines. It also provides a distinct advantage over traditional programs, which restrict choices of research area and faculty advisors.

Admissions

Students usually apply in the fall or winter and begin their studies the following summer. The application deadline is January 15th. Priority will be given to applications received by December 1. Applications will be considered by the Admissions Committee as soon as they are complete. In general a year of biology, organic chemistry and mathematics through calculus are required, and biochemistry and molecular biology are strongly recommended. We also seek students with strong backgrounds in physics or math who may be interested in our Structural Biology track (http://sbb-tp.case.edu) or Systems Biology and Bioinformatics (http://bioinformatics.case.edu) programs. Depending on preparation, we may suggest additional biology coursework once graduate training begins. This background prepares most students for success in our programs.

Research Experience and Recommendations

Experience performing original research is essential. This might include an undergraduate honors thesis, summer research internships, or a technical position after graduation. Letters of recommendation from research mentors that describe creativity, handwork, and promise in science are very important.

Exams

The GRE general test is required. Recent classes have earned an average of 70th percentile in each area. A GRE subject test is desirable, but is not required. The Test of English as a Foreign Language (TOEFL) is required for foreign students unless they are from an English-speaking country or have a degree from a university where the instruction is primarily in English. Students may be eligible to apply for the transfer of some graduate credit from their previous institution. Please go here (http://gradstudies.case.edu) for more information. Transfer credit must be requested prior to beginning coursework at CWRU.

The First Year

Coursework

Students take integrated courses in Cell and Molecular Biology (CBIO 453 Cell Biology I, CBIO 455 Molecular Biology I). These two courses, offered in the fall semester, emphasize the molecular approaches that form the basis of modern biology. We also seek students with strong quantitative training who may have majored in physics or math, and offer alternative courses for these students to acquire foundations in biology. Qualified students also may take more specialized elective courses. All students take IBMS 500: On Being a Professional Scientist: The Responsible Conduct of Research.

Research Rotations

The research rotations allow students to explore research areas and become familiar with faculty members and their laboratories. The main purpose of these rotations is to aid students in selecting a laboratory for their thesis work. Students are encouraged to begin their rotations in July. Doing so gives them the opportunity to complete rotations during the summer before classes begin at the end of August. Students must complete at least three rotations.

Choosing a Thesis Advisor

During the first year, students select an advisor for their dissertation research. Each student also joins the PhD program with which their advisor is affiliated. Once a student has chosen a PhD program, the requirements of that program are followed to obtain the PhD. The emphasis of the PhD work is on research, culminating in the completion of an original, independent research thesis and publishing the results in the scientific literature. PhD programs also focus on educating students to work as professional scientists.

Participating Training Programs

- Biochemistry (p. 745)
- Cell Biology (p. 789)
- Genetics and Genome Sciences (p. 786)
- Molecular Biology and Microbiology (p. 789)
- Molecular Virology (p. 789)
- Neurosciences (p. 797)
- Nutrition (p. 806)
- Pathology (p. 811)
- Pharmacology (p. 824)
- Physiology and Biophysics (p. 835)
- Systems Biology and Bioinformatics (p. 767)

These programs have tracks that allow specialization in the following areas: Cancer Biology; Cancer Therapeutics; Cell and Molecular Physiology; Developmental Biology; Experimental Pathology; Immunology; Membrane Structural Biology; Molecular and Cellular Biophysics; Molecular Pharmacology and Cell Regulation; Molecular Pharmacology and Cell Regulation; Organ Systems Physiology; RNA Biology; Structural Biology & Biophysics; Translational Therapeutics.

Training faculty, course offerings, and individual degree requirements are described in detail in the separate listings for each of these programs. All PhD programs have similar requirements, including an original thesis, coursework, examinations, publications in scientific journals with lead authorship, seminars, journal clubs, and other activities.

BSTP Course

BSTP 400. Research Rotation in Biomedical Sciences Training Program. 0 - 9 Units.
CBIO Courses

CBIO 453. Cell Biology I. 3 Units.
Part of the first semester curriculum for first year graduate students along with CBIO 455. This course is designed to give students an intensive introduction to prokaryotic and eukaryotic cell structure and function. Topics include membrane structure and function, mechanisms of protein localization in cells, secretion and endocytosis, the cytoskeleton, cell adhesion, cell signaling and the regulation of cell growth. Important methods in cell biology are also presented. This course is suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation for this course. Recommended preparation: Undergraduate biochemistry or molecular biology.

CBIO 455. Molecular Biology I. 3 Units.
Part of the first semester curriculum for first year graduate students along with CBIO 453. This course is designed to give students an intensive introduction to prokaryotic and eukaryotic molecular biology. Topics include protein structure and function, DNA and chromosome structure, DNA replication, RNA transcription and its regulation, RNA processing, and protein synthesis. Important methods in molecular biology are also presented. This course is suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation for this course. Recommended preparation: Undergraduate biochemistry or molecular biology.

CBIO 456A. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section A. 1 Unit.
This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The CBIO456A section will cover Nobel Prizes related to the areas of Genetics & Genome Science, Systems Biology & Bioinformatics, and RNA Biology. These include: 1) 2012 Prize, J. Gurdon and S. Yamanaka: Mechanisms of pluripotent stem cell development and reprogramming; 2) 2010 Prize, R. Edwards: Development of in vitro fertilization; 3) 2009 Prize, E. Blackburn, C. Greider, and J Szostack: Mechanisms of chromatin structure and function including RNA polymerase II transcription; 4) 2009 Prize, Y. Ramakrishnan, T. Steitz, and A. Yonath: Structure/function analysis of ribosomes; 5) 2007 Prize, M. Capecchi, M. Evans, and O. Smithies: Discovery/development of transgenic and gene-deletion methods in mice; 6) 2006 Prize, A. Fire and C. Mello: Discovery/development of RNA interference-gene silencing methods; 7) 2006 Prize, R. Kornberg: Mechanisms of eukaryotic transcription; 8) 1995 Prize, E. Lewis, C. Nusslein-Volhard, and W. Wieschaus: Mechanisms of genetic control in early embryonic development.

CBIO 456B. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section B. 1 Unit.
This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The CBIO456B section will cover Nobel Prizes related to the areas of Molecular Biology & Microbiology, Molecular Virology, Pathology-Immunology, and Cell Biology. These include: 1) 2016 Prize, Y. Ohsumi: Mechanisms of Autophagy; 2) 2015 Prize, W. Campbell, S. Omura, and Y. Tu: Therapies against roundworms & malaria; 3) 2011 Prize, B. Beutler, J. Hoffman, and R. Steinman: Mechanisms underlying innate immunity and adaptive immunity; 4) 2008 Prize, H. zur Hausen, F. Barre-Sinoussi, and L. Montagnier: Discovery of human immunodeficiency virus and oncogenic papilloma viruses; 5) 2008 Prize, O. Shimomura, M. Chalfie, and R. Tsien: Discovery/development of green fluorescent protein for biological applications; 6) 2005 Prize, B. Marshall and J. Warren: Discovery of Helicobacter pylori as pathogenic mechanism in peptic ulcers/gastritis; 7) 1999 Prize, G. Blobel: Mechanisms of protein sorting and subcellular trafficking; 8) 1996 Prize, P. Doherty and R. Zinkernagel: Mechanisms of cell-mediated immune defense.

CBIO 456C. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section C. 1 Unit.
This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The CBIO456C section will cover Nobel Prizes related to the areas of Biochemistry, Nutrition, Pharmacology, and Pathology-Cancer. These include: 1) 2015 Prize, T. Lindahl, P. Modrich, and A. Sancar: Mechanisms of DNA Repair; 2) 2014 Prize, E. Betzig, S. Hell, W. Moerner: Development of super-resolution fluorescence microscopy; 3) 2012 Prize, R. Lefkowitz and B. Kobilka: Structure/function analysis of G protein-coupled receptors; 4) 2004 Prize, A. Chien and N. Butcher: Mechanisms of ubiquitin-mediated protein degradation; 5) 2003 Prize, O. Shimomura, M. Chalfie, and R. Tsien: Discovery/development of green fluorescent protein for biological applications; 6) 2002 Prize, B. Marshall and J. Warren: Discovery of Helicobacter pylori as pathogenic mechanism in peptic ulcers/gastritis; 7) 1999 Prize, G. Blobel: Mechanisms of protein sorting and subcellular trafficking; 8) 1996 Prize, P. Doherty and R. Zinkernagel: Mechanisms of cell-mediated immune defense.

CBIO 456D. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section D. 1 Unit.
This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The CBIO456D section will cover Nobel Prizes related to the areas of Genetics & Genome Science, Systems Biology & Bioinformatics, and RNA Biology. These include: 1) 2012 Prize, J. Gurdon and S. Yamanaka: Mechanisms of pluripotent stem cell development and reprogramming; 2) 2010 Prize, R. Edwards: Development of in vitro fertilization; 3) 2009 Prize, E. Blackburn, C. Greider, and J Szostack: Mechanisms of chromatin structure and function including RNA polymerase II transcription; 4) 2009 Prize, Y. Ramakrishnan, T. Steitz, and A. Yonath: Structure/function analysis of ribosomes; 5) 2007 Prize, M. Capecchi, M. Evans, and O. Smithies: Discovery/development of transgenic and gene-deletion methods in mice; 6) 2006 Prize, A. Fire and C. Mello: Discovery/development of RNA interference-gene silencing methods; 7) 2006 Prize, R. Kornberg: Mechanisms of eukaryotic transcription; 8) 1995 Prize, E. Lewis, C. Nusslein-Volhard, and W. Wieschaus: Mechanisms of genetic control in early embryonic development.
CBIO 456D. Since You Were Born: Nobel Prize Biomedical Research in the Last 21 Years- Section D. 1 Unit.

This course is one of four sections that will cover major advances in biomedical research by review of Nobel Prize-winning topics from the past 21 years. Each section will cover 8 Nobel prize topics (1 topic/2 hour session/week for 8 weeks). Students will read critical research papers of the Nobel prize scientist(s) in preparation for guided in-class discussion led by the faculty mentor. The CBIO456D section will cover Nobel Prizes related to the areas of Neuroscience, Physiology & Biophysics, and Pathology-Molecular Basis of Disease. These include: 1) 2014 Prize, J. O'Keefe, M-B. Moser, and E. Moser: Mechanisms of nerve cell spatial positioning in the brain; 2) 2013 Prize, J. Rothman, R. Scheckman, and T. Sudhof: Mechanisms of intracellular vesicle trafficking and biomolecule secretion; 3) 2004 Prize, R. Axel and L. Buck: Structure/function of odorant receptors and organization of olfactory system; 4) 2003 Prize: P. Agre and R. MacKinnon: Structure/function analysis of channel proteins in cell membranes; 5) 2000 Prize, A. Carlsson, P. Greengard, and E. Kandel: Mechanisms of signal transduction in the nervous system; 6) 1998 Prize, R. Furchgott, L. Ignarro, and F. Murad: Discovery/mechanisms of nitric oxide as signaling molecule in cardiovascular system; 7) 1997 Prize, S. Prusiner: Discovery/prions as new biological principle of infection in neurological disease; 8) 1997 Prize, P. Boyer, J. Walker, and J. Skou: Mechanisms of mitochondrial ATP synthesis and Na, K+ATPase pump function.

IBMS Courses

IBMS 450. Fundamental Biostatistics to Enhance Research Rigor & Reproducibility. 1 Unit.

This is a required graduate level course for all first year PhD students in the School of Medicine biomedical PhD programs excluding Biomedical Engineering, Population and Quantitative Health Sciences, Molecular Medicine and Clinical Translation Science. This course focuses on providing students with a basic working knowledge and understanding of best practices in biostatistics that can be applied to common biomedical research activities in numerous fields. Weekly sessions involve a combination of basic programming activities, lectures, exercises, hands-on data manipulation and presentation. Topics include experimental design and power analysis, hypothesis testing, descriptive statistics, linear regression, and others with an emphasis on when and in which experimental design a particular test is properly used. The overall goal of the course is to empower students to use these biostatistics to enhance the rigor of their experimental design and reproducibility of their primary data. The major focus is not on theory, but on a practical acquisition of a working knowledge of basic data processing analysis, interpretation, and presentation skills.

IBMS 500. On Being a Professional Scientist: The Responsible Conduct of Research. 1 Unit.

The goal of this course is to provide graduate students with an opportunity to think through their professional ethical commitments before they are tested, on the basis of the scientific community's accumulated experience with the issues. Students will be brought up to date on the current state of professional policy and federal regulation in this area, and, through case studies, will discuss practical strategies for preventing and resolving ethical problems in their own work. The course is designed to meet the requirements for "instruction about responsible conduct in research" for BSTP and MSTP students supported through NIH/ADAMHA institutional training grant programs at Case. Attendance is required.

Department of Anatomy

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The goal of the Department of Anatomy is to provide individuals with the skills and experiences that will allow them to develop and maintain successful careers as researchers and teachers. The strengths of both the faculty and students of the department help to lead to the achievement of this goal. Graduate studies in the Department of Anatomy can lead to the master of science degree in applied anatomy. The master's degree may be obtained as part of a joint degree program for qualified individuals participating in other programs at the university, such as the joint MD/MS degree. Every MS graduate student in the Department of Anatomy must successfully complete 19 credits in the core curriculum of anatomical sciences, human gross anatomy, histology, neuroanatomy and embryology. Elective course work and, for the thesis MS students, laboratory rotations and research, complete the graduate students' program of study. Research areas of particular strength among faculty in the Department of Anatomy include biological anthropology, cell injury, control of respiration, and non-molecular developmental neurobiology. The department has existing collaborative research efforts with basic scientists in several clinical departments, including medicine, orthopedics, pediatrics, neurology and neurosurgery.

MS Applied Anatomy

The Applied Anatomy program is designed for students who seek a comprehensive education in the anatomical sciences, particularly those individuals pursuing careers as medical health professionals and teachers who desire an advanced degree to enhance their skills and credentials. The Anatomical Sciences Core Curriculum (ASCC) courses emphasize the traditional aspects of anatomical structure, function, and nomenclature with critical aspects of cell and developmental biology, biochemistry, and physiology of cells, tissues, and organs integrated into their content. The elective courses allow curriculum flexibility for students to emphasize their diverse individual interests. The Master of Science in Applied Anatomy serves as an excellent preparation for subsequent studies in schools of medicine, dentistry, and nursing. The knowledge of the human body and its physiological processes gained in this program also forms a significant foundation for physician assistants, physical therapists, dental technicians, and K-12 life sciences teachers.

Students in this post-baccalaureate program earning the Master of Science in Applied Anatomy use their rigorous training in the anatomical sciences to establish an academic basis for their application to professional schools. Case Western Reserve University medical students earning the joint MD/MS degree program seek advanced training in the anatomical sciences. The joint MD/MS program is undertaken and completed concurrently with the medical curriculum, particularly if the student enters the graduate program during the first year of medical school.

Admission

Acceptance into the Master of Science in Applied Anatomy program requires a baccalaureate degree from an accredited institution and is
Degree Requirements
The Master of Science in Applied Anatomy degree requires a minimum of 30 graduate course credits. Required courses include 19 credits of the Anatomical Sciences Core Curriculum; the remaining credits are elective courses selected to fulfill individual student interests and goals. Medical students are required to take at least one of the Surgical Anatomy courses. A research thesis is not required for the non-thesis type B MS Applied Anatomy, although research experience may be obtained as elective coursework ANAT 499: Independent Study with individual faculty members.

Comprehensive written and oral exams covering the basic scientific principles presented in the core curriculum must be passed after successful completion of the formal coursework comprising the Anatomical Sciences Core Curriculum. All degree requirements must be completed within five years; most students complete the program in 2 years. Tuition or stipends will not be provided for the master of science program (no additional tuition is required for enrolled medical students).

These specific sequences of classes, while common, are not exclusive and are meant only to exemplify the typical program of study leading to the Master of Science in Applied Anatomy degree. The required courses (19 credits) comprising the Anatomical Sciences Core Curriculum are specifically delineated, whereas the elective courses (11 credits minimum) are not identified since they vary significantly between individual students. Students become eligible to take the MS Comprehensive Examination upon successful completion of the ASCC courses.

MS & MD/MS Applied Anatomy, Plan of Study (4 semester)
First Year

Fall
ANAT 412 Histology and Ultrastructure (Elective) 4
ANAT 413 General Histology Laboratory () 2
E elective 1-3

Spring
ANAT 411 Gross Anatomy 6
E elective 1-3

(Medical students apply to MD/MS program)

Summer
E elective 1-6

Second Year

Fall
ANAT 414 Neurological Anatomy 4
ANAT 499 Independent Study 1-3

Spring
ANAT 491 Embryology 3
ANAT 499 Independent Study 1-3

Master of Science ASCC Comprehensive Examination (May/June)

(MD/MS Step I Exam)

Year III & IV MD/MS Only:
- [MD/MS- continue clinical/ research rotations]
- Surgical Anatomy courses [1 required- 1 clinical block each]
- Surgical Anatomy I, worth 4 credit hours, to be taken in the fall;
- Surgical Anatomy II, worth 4 credit hours, to be taken in the spring.
  - ANAT 515: ‘Orthopedics’ [ Block 4] 4
  - ANAT 516: ‘Head & Neck’ [ Block 11] 4

[Year IV- Spring: MD/MS Graduation]

Pre-Approved Electives
ANAT 445 Mammal Diversity and Evolution 4
ANAT 467 Topics in Evolutionary Biology 3
ANAT 475 Human Evolution: The Fossil Evidence 3
ANAT 477 Human Osteology 4
ANAT 520 Imaging Anatomy 3
ANAT 560 Applied Neuroanatomy 3
BIOC 407 Introduction to Biochemistry: From Molecules To Medical Science 4
BIOC 408 Molecular Biology 4
PATH 416 Fundamental Immunology 4
ANAT 462 Principles of Developmental Biology 3
PAST 510 Clinical Residency: Elective 3
ANAT 523 Histopathology of Organ Systems 3
PHRM 409 Principles of Pharmacology 3
PHOL 480 Physiology of Organ Systems 4
ANAT 499 Independent Study 1-4
ANAT 503 Readings and Discussions 1-3
ANAT 611 Practicum in Human Gross Anatomy 3

Courses
ANAT 312. Basic Histology. 3 Units.
Fundamental histology course covering microscopic structure, nomenclature, and function of normal cells, tissues, and organs (human emphasis) to provide a sound foundation for bioengineering, pre-medical and pre-dental students.
ANAT 375. Human Evolution: The Fossil Evidence. 3 Units.
This course will survey the biological and behavioral changes that occurred in the hominin lineage during the past five million years. In addition to a thorough review of the fossil evidence for human evolution, students will develop the theoretical framework in evolutionary biology. Recommended preparation: ANTH 377, BIOL 225. Offered as ANAT 375, ANTH 375, ANAT 475 and ANTH 475. Prereq: ANTH 103.

ANAT 377. Human Osteology. 4 Units.
This course for upper division undergraduates and graduate students will review the following topics: human skeletal development and identification; and forensic identification (skeletal aging, sex identification and population affiliation). Offered as ANAT 377, ANTH 377, ANAT 477 and ANTH 477.

ANAT 391. Embryology. 3 Units.
A detailed description of development will be presented, focusing mainly on the developing human. Discussions and presentations will also include several developing systems that have served as useful models in experimental embryology for deciphering mechanisms responsible for producing adult metazoan organisms. Offered as ANAT 391 and ANAT 491.

ANAT 399. Independent Study. 1 - 4 Units.
Laboratory research project. Student must obtain approval of a supervising Anatomy department professor before registration and list the professor’s name on the schedule card.

ANAT 410. Cadaver dissection-based human anatomy with histology and physiologic correlations. 6 Units.
This course will provide students with a sound understanding of the normal human body as a foundation for subsequent pursuing biomedical careers. A combination of daily lectures and laboratories integrates cadaver dissection-based gross anatomy with the associated histology, embryology, neuroanatomy and basic physiology. This course is well-suited to all biomedical careers, including pre-clinical and biomedical undergraduates, post-baccalaureate, pre-clinical master of science graduate programs, plus medical and dental students seeking additional training in the anatomical sciences. It will meet any of the anatomy-oriented prerequisites being implemented for medical and dental school applications, including those preferring or requiring a cadaver-based experience. The assessments will include a combination of written and cadaver-based practical questions. Offered as ANAT 410 and PAST 410.

ANAT 411. Gross Anatomy. 6 Units.
This in-depth, cadaver dissection-based, course covers all aspects of human gross anatomy. The course is modeled after a traditional medical school gross anatomy curriculum and taught by the CWRU School of Medicine, Department of Anatomy faculty. It is divided into three sections: thorax and abdomen; pelvis/perineum and limbs/back; and head and neck. One hour of lecture will precede 3 hours of dissection laboratory Monday, Wednesday, and Friday. Lectures and dissection labs will cover all human anatomy, and students should be prepared to devote more time that the scheduled hours of 1:00 to 5:00pm. Dissection labs are open 24 hours 7 days a week. Recommended preparation: B.A./B.S., or fourth year undergraduate science major.

ANAT 412. Histology and Ultrastructure. 4 Units.
Comprehensive functional histology course integrating microscopic identification (structure plus nomenclature) of normal cells, tissues, and organs with aspects of their cell biology, biochemistry, and physiology (function). Topical coverage includes complete (head-to-toe) tissue and organ survey with human emphasis.

ANAT 413. General Histology Laboratory. 2 Units.
Microscopic structure of tissues and organs. Laboratory course associated with ANAT 412 (see ANAT 412 description). Recommended preparation: ANAT 312 or ANAT 412 or concurrent enrollment.

ANAT 414. Neurological Anatomy. 4 Units.
This course employs a variety of teaching-learning methods—among them lectures, small-group discussions, hands-on “construction” of pathways, and brain dissection. Regional morphology will be studied via examination of the preserved brain and of sections through the CNS; functional systems will be “followed” through the spinal cord, brain stem and/or forebrain.

ANAT 415. Functional Neuroanatomy. 4 Units.
This course focuses on concepts underlying the structure and function of important sensory and motor systems in both the central and peripheral nervous systems. Emphasis is placed on learning how different patterns of neuronal connectivity give rise to certain perceptions and motor behaviors. Additionally, the composition and distribution of peripheral nerves — spinal, cranial, and autonomic — is studied. Particular attention is paid to the anatomy and function of those structures innervated by the cranial nerves. A variety of teaching-learning activities is employed - among them, lectures, small-group discussions, student presentations, and examination of preserved brains and brain sections.

ANAT 424. Neural Integrative and Regulatory Mechanisms. 3 Units.
This course is designed as a sequence to ANAT 414, Neurological Anatomy, or any other “introductory” course in neuroanatomy. Topics to be addressed include central regulation of pain, the regulation of somatic and visceral motor activity, neurotransmitter substances, the basal forebrain, the blood-brain barrier, levels of consciousness, sleep-wake mechanisms, cognitive behaviors and memory. Appreciation of the three-dimensional anatomy and vasculature of the spinal cord and brain will be gained through brain dissection and study of stained and unstained sections. Recommended preparation: ANAT 414 or permission.

ANAT 431. Statistical Methods I. 3 Units.
Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs. First part of year-long sequence. Offered as ANAT 431, BIOL 431, CRSP 431, PQHS 431 and MPHP 431.

ANAT 445. Mammal Diversity and Evolution. 4 Units.
This course focuses on the anatomical and taxonomic diversity of mammals in an evolutionary context. The emphasis is living (extant) mammals, but extinct mammals are also discussed. By the end of the course, students will be able to: (1) describe the key anatomical and physiological features of mammals; (2) name all orders and most families of living mammals; (3) identify a mammal skull to order and family; (4) understand how to create and interpret a phylogenetic tree; (5) appreciate major historical patterns in mammal diversity and biogeography as revealed by the fossil record. Two student-led seminars and one lab each week. Most labs will take place at the Cleveland Museum of Natural History. One weekend field trip to Cleveland Metroparks Zoo. This course satisfies a laboratory requirement for the biology major. Offered as ANAT 445, BIOL 345, and BIOL 445. Prereq: BIOL 214.

ANAT 462. Principles of Developmental Biology. 3 Units.
The descriptive and experimental aspects of animal development. Gametogenesis, fertilization, cleavage, morphogenesis, induction, differentiation, organogenesis, growth, and regeneration. Students taking the graduate-level course will prepare an NIH-format research proposal as the required term paper. Offered as BIOL 362, BIOL 462 and ANAT 462.
ANAT 467. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467.

ANAT 475. Human Evolution: The Fossil Evidence. 3 Units.
This course will survey the biological and behavioral changes that occurred in the hominin lineage during the past five million years. In addition to a thorough review of the fossil evidence for human evolution, students will develop the theoretical framework in evolutionary biology. Recommended preparation: ANTH 377, BIOL 225. Offered as ANAT 375, ANTH 375, ANAT 475 and ANTH 475. Prereq: ANTH 103.

ANAT 477. Human Osteology. 4 Units.
This course for upper division undergraduates and graduate students will review the following topics: human skeletal development and identification; and forensic identification (skeletal aging, sex identification and population affiliation). Offered as ANAT 377, ANTH 377, ANAT 477 and ANTH 477.

ANAT 491. Embryology. 3 Units.
A detailed description of development will be presented, focusing mainly on the developing human. Discussions and presentations will also include several developing systems that have served as useful models in experimental embryology for deciphering mechanisms responsible for producing adult metazoan organisms. Offered as ANAT 391 and ANAT 491.

ANAT 497. Scientific Presentations. 1 Unit.
These courses provide a foundation and experience for making scientific presentations. Scheduled simultaneously with ANAT 498 and students from both courses are present, but the requirements for passing differ. Students in ANAT 497 prepare PowerPoint and poster presentations. Oral presentations by students taking ANAT 498 will occur during the class periods for the remainder of the semester. Students taking 497 and 498 must participate in these discussions. Students must take ANAT 497: Scientific Presentations before ANAT 498: Applied Anatomy Seminar.

ANAT 498. Applied Anatomy Seminar. 1 Unit.
These courses provide a foundation and experience for making scientific presentations. Scheduled simultaneously with ANAT 497 and students from both courses are present, but the requirements for passing differ. Students in ANAT 497 prepare PowerPoint and poster presentations. Oral presentations by students taking ANAT 498 will occur during the class periods for the remainder of the semester. Students taking 497 and 498 must participate in these discussions. Students must take ANAT 497: Scientific Presentations before ANAT 498: Applied Anatomy Seminar.

ANAT 499. Independent Study. 1 - 4 Units.
Laboratory research project. Student must obtain approval of a supervising Anatomy department professor before registration and list the professor's name on the schedule card.

ANAT 503. Readings and Discussions. 1 - 3 Units.
In-depth consideration of special selected topics through critical evaluation of the literature. Student must obtain approval of supervising Anatomy department professor before registration.

ANAT 513. Surgical Anatomy of the Thorax and Abdomen. 4 Units.
This course is intended for graduate and fourth-year medical students interested in surgery and surgical subspecialties. This integrated course will review basic gross anatomy, provide advanced training in gross and surgical anatomy, introduce common clinical problems and their anatomical consequences, and basic surgical approaches. Recommended preparation: ANAT 411 and permission of instructor.

ANAT 515. Surgical Anatomy: Orthopaedic Musculoskeletal. 4 Units.
This orthopaedic musculoskeletal anatomy course is offered to M.S. in Applied Anatomy students and fourth year medical students. The course will familiarize participants with surgical approaches used to treat musculoskeletal disease. Students will learn to correlate normal and abnormal anatomical findings with radiographical studies. Recommended preparation: ANAT 411.

ANAT 516. Surgical Anatomy: Head and Neck. 4 Units.
This cadaver-based advanced anatomy course is offered to M.S. in Applied Anatomy students and fourth year medical students. Students will build on their understanding of basic gross, histological, pathologic, and embryonic anatomy of the head and neck. The course will familiarize participants with surgical approaches used to treat pathological conditions of the head and neck including cranial cavity, cranial base, orbit, maxillofacial, oral, otic, pharyngeal, and airway. Students are required to attend and participate in lectures, surgical labs, and discussions in order to successfully complete the course. Instructor consent is required. Recommended preparation: ANAT 411.

ANAT 520. Imaging Anatomy. 3 Units.
Imaging anatomy will reinforce the student's knowledge of anatomy and introduce the field of radiology. Students would be motivated to broaden their understanding of anatomy by being exposed to the application of that knowledge. The curriculum would introduce radiologic concepts, while stressing the normal anatomy of organ systems by imaging modalities. Anatomical structures will be recognized by projectional and cross-sectional modalities. The student will be expected to demonstrate the anatomical characteristics of that structure by oral or written account, for example course, area of supply, relations, morphology, etc. Recommended Preparation: Comprehensive knowledge of human anatomy, such as ANAT 411.

ANAT 523. Histopathology of Organ Systems. 3 Units.
Comprehensive course covering the underlying basic mechanisms of injury and cell death, inflammation, immunity, infection, and neoplasia followed by pathology of specific organ systems. Material will include histological ('structure') and physiological ('function') aspects related to pathology (human emphasis). Recommended preparation: ANAT 412 or permission of instructor. Offered as ANAT 523 and PATH 523.

ANAT 560. Applied Neuroanatomy. 3 Units.
This course is constructed to reinforce the student's understanding of neuroanatomy. Through problem-based learning the student will set their own learning objectives based on a neurosurgical case. Presentations will use imaging, anatomic diagrams, and cadaveric dissection to demonstrate applications. Learning in this clinical context will increase motivation and understanding of this important subject. Primarily for medical students and graduate students, enrollment is by permission of instructor and completing ANAT 414, Neurological Anatomy. Prereq: ANAT 414.
ANAT 610. Oxygen and Physiological Function. 3 Units.
Lecture/discussion course which explores the significance and consequences of oxygen and oxygen metabolism in living organisms. Topics to be covered include oxygen transport by blood tissues, oxygen toxicity, and mitochondrial metabolism. Emphasis will be placed on mammalian physiology with special reference to brain oxidative metabolism and blood flow as well as whole body energy expenditure and oxidative stress related to disease. The course will cover additional spans of physiology, nutrition and anatomy. Offered as ANAT 610, NTRN 610, and PHOL 610.

ANAT 611. Practicum in Human Gross Anatomy. 3 Units.
A course of study designed especially for the preparation of teachers that involves the supervised practical application of previously studied theory. The teaching experience obtained will be obtained in ANAT 411 - Human Gross Anatomy. Teaching will be guided, supervised, and evaluated by the appropriate faculty from the department of anatomy. The three sections of ANAT 611 and the subjects covered are: Trunk Gross Anatomy (6 weeks), Musculoskeletal Gross Anatomy (3 weeks), Head & Neck Gross Anatomy (4 weeks). Required preparation: ANAT 411 and permission of instructor.

ANAT 612. Practicum in Histology and Ultrastructure. 2 Units.
A course of study designed especially for the preparation of teachers that involves the supervised practical application of previously studied theory. The prerequisite knowledge required for ANAT 612 must have been obtained previously in ANAT 412: Histology and Ultrastructure and the associated laboratory ANAT 413: Histology Laboratory. Required participation in ANAT 612 is defined as: 1. Meet weekly with course instructor to (pre)review course material; 2. Attend all ANAT 412 lectures; 3. Participate/assist in all ANAT 413 laboratory sessions. Teaching will be guided, supervised, and evaluated by the course instructor with reference to the graduate student’s overall progress and performance as a teacher. Required prerequisites: ‘A’ grades on ANAT 412 and ANAT 413; permission of instructor required.

ANAT 614. Practicum in Neurological Anatomy. 1 Unit.
A course of study designed especially for the preparation of teachers that involves the supervised practical application of previously studied theory. The graduate student will administer all laboratory sessions, assisting students with identification of structures and with understanding the functional aspects of neuroanatomical pathways. The graduate student will meet with the course director once per week to discuss the student’s performance and progress and to plan for upcoming class sessions. The course director will assist the student in developing the organizational skills necessary to be a course director as the student learns to anticipate questions, define problematic areas, and recognize varying learning styles. The graduate student will be evaluated by the course director with reference to the graduate student’s overall progress and performance as a teacher. Recommended prerequisites: one semester of human anatomy with laboratory.

ANAT 651. Thesis M.S.. 1 - 9 Units.
Master’s Thesis Plan A.

ANAT 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Jennifer Puin, PhD
Director of Admissions
info@anesthesiaprogram.com or 216.844.8077
http://case.edu/medicine/msa-program

The Department of Anesthesiology and Perioperative Medicine medical division of University Hospitals Cleveland Medical Center includes more than fifty attending anesthesiologists on staff supervising resident anesthesiologists and anesthetists to provide the best patient care.

The Anesthesiologist Assistant (AA) program at Case Western Reserve University began in 1970 and originally awarded a baccalaureate degree, evolving into a professional postgraduate curriculum in 1987 and granting the Master of Science degree. Admission to the AA program requires a bachelor’s degree with prescribed prerequisites typical of premedical course work and successful completion of the MCAT. The application deadline for the CWRU program is October 1 of each year for admission into the class that starts at the end of May. The 24-month AA program is accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP) and is based on the Standards for Anesthesiologist Assistant Programs. Graduates must complete a curriculum that includes 68 credit hours (six semesters) of classroom and clinical instruction. The first three semesters integrate basic science and clinical instruction.

CWRU also oversees the Master of Science in Anesthesia Program’s Houston, Texas campus (http://case.edu/medicine/msa-program/locations/houston-tx) and Washington, DC campus (http://case.edu/medicine/msa-program/locations/washington-dc).

The program is led by Joseph M. Rifici, CAA, MEd, and Matthew P. Norcia, MD. More information can be obtained from Jennifer Puin (info@anesthesiaprogram.com), Director of Admissions.

Master of Science in Anesthesia Degree

The Master of Science in Anesthesia (MSA) Program mission is to graduate skilled and compassionate anesthesiologist assistants. The admission policy reflects this goal. Applicants are considered on a variety of parameters that measure academic ability, communication skills, clinical aptitude, and personality traits.

Admission to the MSA Program requires that the following criteria are met:

A. Bachelor's degree from an accredited college or university

Documentation of each of the prerequisites listed below having been completed with a grade of B- or higher within five (5) years prior to the application deadline at an accredited American or Canadian institution of higher learning. For those courses that have been repeated, the highest grade will be used in the calculation.

- one semester of biochemistry
- one year of biology with laboratory*
- one semester of human anatomy with laboratory
- one semester of human physiology
- one year of chemistry with laboratory*
- one year of organic chemistry with laboratory*
- one year of physics with laboratory*
- one semester of calculus*
- one semester of advanced statistics (preferably for the life sciences)*

Anesthesiologist Assistant Program

Master of Science in Anesthesia Program

Joseph M. Rifici, CAA, MEd
Executive Program Director
• one semester of English with expository writing*

* If any of the above courses marked with an asterisk were completed (with a grade of B- or higher) in excess of five (5) years prior to the application deadline, they will meet the prerequisite criteria only if the composite score of the MCAT is 500 or higher.

B. Medical College Admission Test

• minimum composite score of 493
• test must have been completed within 3 years of application deadline
• when the MCAT has been taken more than once, component scores from different exams may not be combined

Applicants with international undergraduate, graduate or advanced degrees must meet the standard admission requirements listed above. International application requirements also include the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System) and Education Credential Evaluation Reports for foreign transcripts.

All materials must be received by the deadline, October 1st. Candidates participate in interviews with members of the Admissions Committee, which is comprised of faculty and staff members of the MSA Program. All academic requirements must be completed satisfactorily before matriculation. Prospective candidates are permitted and encouraged to shadow an anesthetist in the OR. Prior approval for this visitation is required.

The 24-month program includes 68 credit hours (six semesters) of classroom and clinical instruction. The first three semesters integrate basic science and clinical instruction. During the remaining 3 semesters, students complete month-long rotations in all subspecialties of anesthesiology: ambulatory surgery, burns and trauma, cardiothoracic surgery, general surgery, neurosurgery, obstetrics, pediatrics, surgical intensive care unit. Clinical training focuses on all types of anesthesia including general, epidural, spinal and peripheral nerve blockade.

Instruction is also provided in advanced patient care monitoring techniques and pre-testing, calibration and operation of anesthesia delivery systems and monitors. At CWRU our personal approach and rigorous educational standards produce compassionate and highly skilled anesthesiologist assistants.

The MSA Program is accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP) and is based on the Standards for Anesthesiologist Assistant Programs. Graduates sit for the Certification Examination administered by the National Commission for Certification of Anesthesiologist Assistants (NCCAA) and co-sponsored by the National Board of Medical Examiners (NBME).

Additional information may be found on the Master of Science in Anesthesia Program website (http://case.edu/medicine/msa-program).

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**MS Anesthesiologist Assistant, Plan of Study**

### Basic Science Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
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<tr>
<td>Cardiac Electrophysiology (ANES 403)</td>
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<tr>
<td>Applied Physiology for Anesthesiologist Assistants I (ANES 456)</td>
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### Clinical Year

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<tr>
<th>Course</th>
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<tr>
<td>Anesthesia Clinical Correlation I (ANES 462)</td>
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<td>Anesthesia Clinical Experience I (ANES 463)</td>
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<td>Pharmacology for Anesthesiologist Assistants I (ANES 475)</td>
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<td>Fundamentals of Anesthetic Sciences I (ANES 480)</td>
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<tr>
<td>Physiological Model-Based Simulation I (ANES 486)</td>
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</tr>
<tr>
<td>Anesthesia Non-Technical Skills Lab (ANES 488)</td>
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<td></td>
</tr>
</tbody>
</table>

Minimum Clinical Experience Required = 511 hours
### Anesthesiologist Assistant Program

**ANES 403. Cardiac Electrophysiology. 2 Units.**
In this course students will learn basic and advanced Electrocardiogram (ECG) interpretation using simulators and electrocardiograms to understand an overview of heart anatomy, function, and neurophysiology.

**ANES 440. Patient Monitoring and Instrumentation I. 2 Units.**
Students are taught the proper balance between circuits and engineering concepts and the clinical application of anesthesia instrumentation. Monitors and devices used in the operating room are studied with respect to principles of operation, calibration, and interpretation of data. A hands-on laboratory is utilized to maximize direct contact to the instrumentation of the profession.

**ANES 441. Patient Monitoring and Instrumentation II. 2 Units.**
Continuation of ANES 440. Recommended preparation: ANES 440.

**ANES 456. Applied Physiology for Anesthesiologist Assistants I. 3 Units.**
Basic and applied human systems physiology with emphasis on topics and areas of special concern to the anesthetist.

**ANES 458. Applied Physiology for Anesthesiologist Assistants II. 3 Units.**
Continuation of ANES 456. Recommended preparation: ANES 403 and ANES 456.

**ANES 460. Introduction to Anesthesia. 2 Units.**
Introduction to basic concepts dealing with clinical anesthesia. Medical terminology, human anatomy, medical chart interpretation and drug dosage calculations.

**ANES 461. Orientation to Clinical Experience. 3 Units.**
Introduction to experience in the operating room with emphasis on the fundamental procedures and techniques used in administering an anesthetic. Preoperative assessment, IV placement techniques, airway management, intraoperative patient care and postoperative management are all emphasized in this course. BLS (basic life support) certification is required for course completion. Recommended preparation: Acceptance in the M.S.A. program.

**ANES 462. Anesthesia Clinical Correlation I. 1 Unit.**
A series of conferences presented by students that applies to anesthetic theory as it relates to the clinical experience. Specific anesthetic situations are emphasized. Recommended preparation: ANES 460.

**ANES 463. Anesthesia Clinical Experience I. 3 Units.**
A continuation of the preparation, observation, and hands-on learning format initiated in ANES 461. Patient management and technical skills are refined with close attention to the didactic course work. A comprehensive clinical examination is administered at the end of the semester. ACLS (Advanced Cardiac Life Support) certification is required for course completion. Recommended preparation: ANES 461.

**ANES 464. Anesthesia Clinical Correlation II. 1 Unit.**
A spectrum of case presentation conferences presented by the students dealing with basic and major problems in anesthesia management. Medical and surgical history of individual patients and the outcomes of anesthesia and surgery are emphasized. Journal Club and Morbidity and Mortality conferences are included. Recommended preparation: ANES 462.

**ANES 465. Anesthesia Clinical Experience II. 4 Units.**
A continuation of ANES 463. A comprehensive clinical examination is administered at the end of the semester. PALS (Pediatric Advanced Life Support) and ACLS (Advanced Cardiac Life Support) certification is required for course completion. Recommended preparation: ANES 463, BLS Certification, ACLS Certification.

**ANES 467. Anesthesia Clinical Experience III. 4 Units.**
Extended exposure to all of the clinical subspecialties of anesthesiology (obstetrics, pediatrics, neurosurgery, cardiovascular, etc.). Students alternate through rotations at several area hospitals. Recommended preparation: ANES 465, ACLS certification and PALS.

**ANES 468. Anesthesia Clinical Correlation III. 1 Unit.**

**ANES 469. Anesthesia Clinical Experience IV. 8 Units.**
A continuation of ANES 467. A comprehensive clinical examination is administered at the end of the semester. Recommended preparation: ANES 467.

**ANES 470. Anesthesia Clinical Correlation IV. 1 Unit.**

**ANES 471. Anesthesia Clinical Experience V. 8 Units.**
A continuation of ANES 469. A comprehensive clinical examination is administered at the end of the semester. Recommended preparation: ANES 469.

**ANES 475. Pharmacology for Anesthesiologist Assistants I. 3 Units.**
Pharmacodynamics, pharmacokinetics, uptake, distribution and action of the volatile and intravenous anesthetics, muscle relaxants, narcotics, hypnotics and other pharmaceuticals used in the administration of an anesthetic. Prereq: Consent of Department.

**ANES 476. Pharmacology for Anesthesiologist Assistants II. 3 Units.**
Continuation of ANES 475. Prereq: ANES 475.
ANES 477. Clinical Decision Making in Anesthesia. 2 Units.
An introduction to thinking about clinical situations and problems and coming to safe and effective solutions to these problems. This course focuses on common clinical situations where appropriate decision making is important to the outcome of the case. Numerous areas of medicine and anesthesiology will be covered to provide the student with a wide sampling of decisions made each day with patient care. This course supplements the other courses offered during the spring semester by integrating and applying basic science knowledge to the care of patients. Prereq: Consent of department.

ANES 480. Fundamentals of Anesthetic Sciences I. 1 Unit.
A continuum of courses over the fall and spring semesters that covers a series of topics in basic medical science with special emphasis on the effect of anesthetics on normal physiology. An examination is administered at the end of each semester.

ANES 481. Fundamentals of Anesthetic Sciences II. 1 Unit.
A series of topics in basic medical science with special emphasis on the effect of anesthetics on normal physiology. An examination is administered at the end of the semester. Prereq: ANES 480.

ANES 485. Introduction to Physiological Model-Based Simulation. 1 Unit.
Introduction to physiological model-based simulation using on-screen computer simulation and mannequins. Emphasis is placed on improving appropriate anesthesia-related basic science knowledge, manual skills in anesthesia machine checkout, drug and equipment setup, safety inspections, and performing anesthesia for uncomplicated surgical cases.

ANES 486. Physiological Model-Based Simulation I. 1 Unit.
An extension of ANES 485 with emphasis on improving or exercising knowledge of anesthesia-appropriate basic science, the use of more advanced equipment and techniques for uncomplicated surgical cases with an introduction to crisis management. Recommended preparation: ANES 485.

ANES 487. Physiological Model-Based Simulation II. 1 Unit.
An extension of ANES 486 emphasizing the physical techniques aspects of crisis management, team work and rescue in anesthesia, including support for and review of training in Basic Life Support and Advanced Cardiac Life Support. Recommended preparation: ANES 486.

ANES 488. Anesthesia Non-Technical Skills Lab. 1 Unit.
In this course the student will learn anesthesia non-technical skills, which are used integrally with medical knowledge and clinical techniques. They encompass both interpersonal skills (e.g. communication, team working, leadership) and cognitive skills (e.g. situation awareness, decision making). This course uses modified Crew Resource Management techniques taught in the aviation industry and considers the limitations of human performance and the nature of human error. The goals are to train individuals to avoid, capture and mitigate against the consequences of error. During the course, behaviors shown to minimize errors and maximize patient safety are highlighted and then practiced, with feedback being given to students on their performance.

ANES 490. Ethics, Law and Diversity for Anesthesiologist Assistants. 2 Units.
This course will focus on three topics. First, a discussion of legal practice as it applies to health care including basics of medical jurisprudence, negligence, and how to avoid a lawsuit. Second, a discussion of ethical theory including the principles of medical ethics, do not resuscitate, truth telling, and assessment of competence. Last, a discussion on diversity that will focus on the differences and similarities among people and how these factors influence patient care. The final grade will be based on an essay and a multiple choice exam.

ANES 499. Clinical Remediation. 1 - 10 Units.
(Credit as arranged.) Course offered to the student one time during the program of study which remediates "C" or below work in a clinical course.

ANES 580. Fundamentals of Anesthetic Sciences III. 1 Unit.
The second-year equivalent of ANES 480 and ANES 481. An examination is administered at the end of the semester. Recommended preparation: ANES 480 and ANES 481.

ANES 581. Fundamentals of Anesthetic Sciences IV. 1 Unit.
The second year equivalent of ANES 481. An examination is administered at the end of the semester. Prereq: ANES 580.

ANES 584. Physiological Model-Based Simulation III. 1 Unit.
An extension of ANES 487 emphasizing the physical techniques and aspects of crisis management, team work, and rescue in anesthesia. Prereq: ANES 487.

ANES 585. Physiological Model-Based Simulation IV. 1 Unit.
Extension of ANES 584 emphasizing the physical techniques and aspects of crisis management, team work, and rescue in anesthesia. Prereq: ANES 584.

ANES 599. Clinical Remediation. 1 - 10 Units.
(Credit as arranged.) Course offered to the student one time during the program of study which remediates "C" or below work in a clinical course.

Department of Biochemistry

Room W-427, School of Medicine
http://www.case.edu/med/biochemistry/
Phone: 216.368.3334; Fax: 216.368.3419
Walter F. Boron, MD, PhD, Interim Chair
walter.boron@case.edu

Department Coordinator (biochemistry@case.edu)

Biochemistry is the study of the molecular basis of cellular function, making it a central discipline in the biological sciences. Biochemists ask the question, "How do life processes work at the molecular level?" The Department of Biochemistry offers undergraduate programs leading to the bachelor of arts degree and bachelor of science degree in biochemistry and graduate programs leading to the master of science, doctor of philosophy, and dual-degree programs as follows: doctor of medicine/doctor of philosophy degree; doctor of medicine/masters of science in biomedical investigation; juris doctor/masters of science in biochemistry.

The department also participates in several interdisciplinary and interdepartmental programs in the School of Medicine and at Case Western Reserve University that provide additional avenues of study. Research interests within the department include a spectrum of modern biochemical topics in six broad areas: enzymology, protein chemistry, structural biology, gene expression, cell biology, and molecular medicine/gene therapy. The department has state-of-the-art equipment and facilities for research in modern biochemistry. More complete information about the undergraduate and graduate programs may be obtained by contacting the departmental office or by using the URL above.

Research Areas

Research of Department of Biochemistry faculty members covers a broad spectrum of topics from events at the level of electron movement in biochemical reactions to the intracellular trafficking of proteins. Research in the department is broadened by collaborations with faculty in other university departments and with scientists at other Cleveland research
institutions. The areas of active research within the department are outlined below.

**Proteins and Enzymes**
Proteins are components of all living tissue, and their function is critical for life processes. Understanding the chemical mechanisms of enzymatic catalysis is essential for determining the role of individual proteins in human disease. Biochemistry faculty study a variety of proteins and enzymes ranging from growth factors to oncogenes.

**Structural Biology**
The function of a protein is determined by its three-dimensional structure and interactions. Faculty apply many modern techniques to the determination of macromolecular structure, including X-ray crystallography, and multidimensional heteronuclear NMR, fluorescence, Raman, and circular dichroism spectroscopy. Macromolecules under investigation include, transcarboxylase, ribosomes, DNA-protein complexes, and neurochemical enzymes.

**Regulation of Gene Expression**
The elucidation of mechanisms regulating gene expression is a major goal of modern biology. Biochemistry faculty study the control of transcription by hormones and other regulatory molecules, the interaction between proteins and DNA, the function of oncogenes, the basal and hormone mediated transcriptional machinery, and the processing and translation of RNA.

**Cell Biology**
The control of the metabolism, differentiation and cell signaling within and between cells is an area of active investigation.

**Metabolic Regulation**
Biochemistry faculty investigate the control of metabolism in animals, such as dietary and hormonal regulation of gene expression. Transgenic murine technology allows the study of the impact of gene ablation on metabolic processes.

**Major**
The two undergraduate major programs in Biochemistry, BA and BS, are based on the Arts and Sciences General Education Requirements, but differ in amount and intensity of the mathematics and physical sciences required. Either degree is excellent for students planning to undertake graduate work in biochemistry or in related areas of the biomedical sciences. Both the BA and the BS programs permit students to follow many options after graduation. Graduates are well prepared to pursue further studies in the biological sciences, for a career in medicine, for Doctor of Pharmacy programs, for employment in the chemical, pharmaceutical, and biotechnology industries, or as research assistants in research laboratories. The BA has a reduced emphasis on the quantitative aspects of science and makes available a considerable amount of elective time that permits a student to either concentrate on biochemistry even more intensively than the curriculum requires, or pursue other subjects in science or liberal arts. The BS degree is for the student who has a particularly strong interest in the quantitative physical sciences.

In both programs, undergraduate research is required. As many as nine hours of Research in Biochemistry (BIOC 391 Research Project) may be credited toward the requirements for graduation. The capstone in Biochemistry (BIOC 393 Senior Capstone Experience) is a thesis and presentation of a student’s undergraduate research studies.

### Bachelor of Arts in Biochemistry

**Required Courses:**

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<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOM 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>4</td>
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<tr>
<td>BIOM 308</td>
<td>Molecular Biology</td>
<td>4</td>
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<tr>
<td>BIOM 373</td>
<td>Biochemistry SAGES Seminar (SAGES Departmental Seminar)</td>
<td>3</td>
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<tr>
<td>Biochemistry elective:</td>
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<td>3</td>
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<tr>
<td>BIOM 312</td>
<td>Proteins and Enzymes</td>
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<tr>
<td>or BIOM 334</td>
<td>Structural Biology</td>
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<tr>
<td>Two approved technical electives in biochemistry</td>
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<td>6</td>
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<tr>
<td>BIOM 393</td>
<td>Senior Capstone Experience</td>
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**Additional Required Courses:**

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<tbody>
<tr>
<td>BIOM 214</td>
<td>Genes, Evolution and Ecology</td>
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<tr>
<td>&amp; 214L</td>
<td>and Genes, Evolution and Ecology Lab</td>
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<tr>
<td>BIOM 215</td>
<td>Cells and Proteins</td>
<td>4</td>
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<tr>
<td>&amp; 215L</td>
<td>and Cells and Proteins Laboratory</td>
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<tr>
<td>CHEM 105</td>
<td>Principles of Chemistry I</td>
<td>3-4</td>
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<td>or CHEM 111</td>
<td>Principles of Chemistry for Engineers</td>
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<td>CHEM 106</td>
<td>Principles of Chemistry II</td>
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<td>or ENGR 145</td>
<td>Chemistry of Materials</td>
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<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
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<td>CHEM 223</td>
<td>Introductory Organic Chemistry I</td>
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<td>or CHEM 323</td>
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<td>or CHEM 324</td>
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<td>CHEM 234</td>
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<td>CHEM 301</td>
<td>Introductory Physical Chemistry I</td>
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<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
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<td>or MATH 121</td>
<td>Calculus for Science and Engineering I</td>
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<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
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<td>or MATH 122</td>
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<td>PHYS 115</td>
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<td>or PHYS 121</td>
<td>General Physics I - Mechanics</td>
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<td>PHYS 116</td>
<td>Introductory Physics II</td>
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<tr>
<td>or PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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**Total Units** 66-68

### BA Biochemistry, Sample Plan of Study

**Freshman**

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<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I (MATH 125)</td>
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<td>Principles of Chemistry I (CHEM 105) or Principles of Chemistry for Engineers (CHEM 111)</td>
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<td>Independent Activity (PHED 100)</td>
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<tr>
<td>SAGES First Seminar</td>
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</table>
Genes, Evolution and Ecology (BIOL 214) & Genes, Evolution and Ecology Lab (BIOL 214L) 4
Math and Calculus Applications for Life, Managerial, and Social Sci II (MATH 126) 4
Principles of Chemistry II (CHEM 106) or Chemistry of Materials (ENGR 145) 3
Principles of Chemistry Laboratory (CHEM 113) 2
SAGES University Seminar I 3
Cells and Proteins (BIOL 215) & Cells and Proteins Laboratory (BIOL 215L) 4
Independent Activity (PHED 100) 0-10
Year Total: 15-25

Sophomore

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<td>Introductory Organic Chemistry I (CHEM 223)(^a)</td>
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<tr>
<td>Introductory Organic Chemistry Laboratory I (CHEM 233)</td>
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<tr>
<td>Introductory Physics I (PHYS 115)</td>
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<tr>
<td>GER Course</td>
<td>3</td>
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<tr>
<td>SAGES University Seminar II</td>
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<tr>
<td>Introductory Organic Chemistry II (CHEM 224)(^a)</td>
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<tr>
<td>Introductory Organic Chemistry Laboratory II (CHEM 234)</td>
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<tr>
<td>Introductory Physics II (PHYS 116)</td>
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<td>GER Course</td>
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<td>Elective</td>
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<td>Year Total:</td>
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Junior

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<tr>
<td>Introductory Physical Chemistry I (CHEM 301)</td>
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<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 307)</td>
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<td>GER Course</td>
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<tr>
<td>Electives</td>
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<td>Molecular Biology (BIOC 308)</td>
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<tr>
<td>Approved Technical Elective(^b)</td>
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<td>Research Project (BIOC 391)</td>
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<tr>
<td>Electives</td>
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Senior

<table>
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<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tr>
<td>Biochemistry SAGES Seminar (BIOC 373)</td>
<td>3</td>
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<tr>
<td>Research Project (BIOC 391)</td>
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</tr>
<tr>
<td>Approved Biochemistry or Technical Elective(^b)</td>
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<tr>
<td>Electives</td>
<td>6</td>
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<tr>
<td>Senior Capstone Experience (BIOC 393)</td>
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<tr>
<td>Approved Biochem or Technical Elective(^b)</td>
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<td>Electives</td>
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Total Units in Sequence: 120-143

Note: At least the 3 credits of undergraduate research, BIOC 391 Research Project, is minimally recommended for the Capstone. An additional 3 credits of BIOC 391 is highly recommended. Students should consult their academic advisers about the elective parts of the curriculum.

\( ^a\) Selected students may be invited to take CHEM 323 Organic Chemistry I, CHEM 324 Organic Chemistry II.

\( ^b\) One of the approved electives in Biochemistry taken must be either BIOC 312 Proteins and Enzymes or BIOC 334 Structural Biology.

---

**Bachelor of Science in Biochemistry**

**Required Courses:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 308</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 312</td>
<td>Proteins and Enzymes</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 334</td>
<td>Structural Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 373</td>
<td>Biochemistry SAGES Seminar</td>
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<tr>
<td>Approved Technical Elective in Biochemistry</td>
<td>3</td>
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</tr>
<tr>
<td>BIOC 393</td>
<td>Senior Capstone Experience</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 214 &amp; 214L</td>
<td>Genes, Evolution and Ecology and Genes, Evolution and Ecology Lab</td>
<td>4</td>
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<tr>
<td>BIOL 215 &amp; 215L</td>
<td>Cells and Proteins and Cells and Proteins Laboratory</td>
<td>4</td>
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<tr>
<td>CHEM 105 or CHEM 111</td>
<td>Principles of Chemistry I</td>
<td>3-4</td>
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<tr>
<td>CHEM 106 or ENGR 145</td>
<td>Principles of Chemistry II</td>
<td>3-4</td>
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<tr>
<td>CHEM 113</td>
<td>Principles of Chemistry Laboratory</td>
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<tr>
<td>CHEM 223 or CHEM 323</td>
<td>Organic Chemistry I</td>
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<td>CHEM 224 or CHEM 324</td>
<td>Organic Chemistry II</td>
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<td>CHEM 301 or CHEM 335</td>
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<td>CHEM 302 or CHEM 336</td>
<td>Introductory Physical Chemistry II</td>
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<td>CHEM 233</td>
<td>Introductory Organic Chemistry Laboratory I</td>
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<tr>
<td>CHEM 234</td>
<td>Introductory Organic Chemistry Laboratory II</td>
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<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
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<td>Course</td>
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<tr>
<td>MATH 224</td>
<td>Elementary Differential Equations</td>
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<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
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<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>4</td>
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<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td></td>
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<tr>
<td>PHYS 221</td>
<td>Introduction to Modern Physics</td>
<td>3</td>
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<tr>
<td>Statistics/data analysis elective</td>
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<td>3</td>
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<tr>
<td>PHYS 250</td>
<td>Computational Methods in Physics</td>
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<tr>
<td>STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
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</tr>
<tr>
<td>STAT 313</td>
<td>Statistics for Experimenters</td>
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<tr>
<td>or equivalent</td>
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**Total Units: 83-85**

### BS Biochemistry, Sample Plan of Study

#### Freshman

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<tbody>
<tr>
<td>Calculus for Science and Engineering I (MATH 121)</td>
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<tr>
<td>or Principles of Chemistry I (CHEM 105)</td>
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<td></td>
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<tr>
<td>or Principles of Chemistry for Engineers (CHEM 111)</td>
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<td>Independent Activity (PHED 100)</td>
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<td>SAGES First Semester</td>
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<td>Genes, Evolution and Ecology (BIOL 214) &amp; Genes, Evolution and Ecology Lab (BIOL 214L)</td>
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<td>or Principles of Chemistry II (CHEM 106)</td>
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<td>or Chemistry of Materials (ENGR 145)</td>
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<td>Principles of Chemistry Laboratory (CHEM 113)</td>
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<td>SAGES University Seminar I</td>
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<td>Independent Activity (PHED 100)</td>
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#### Sophomore

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<tr>
<td>Introductory Organic Chemistry I (CHEM 223)</td>
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<tr>
<td>Introductory Organic Chemistry Laboratory I (CHEM 233)</td>
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<td>2</td>
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<tr>
<td>Calculus for Science and Engineering III (MATH 223)</td>
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<td>General Physics I - Mechanics (PHYS 121)</td>
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<td>GER Course</td>
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<tr>
<td>Introductory Organic Chemistry II (CHEM 224)</td>
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<tr>
<td>Introductory Organic Chemistry Laboratory II (CHEM 234)</td>
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<tr>
<td>Elementary Differential Equations (MATH 224)</td>
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<td>General Physics II - Electricity and Magnetism (PHYS 122)</td>
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<td>GER Course</td>
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#### Junior

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<tr>
<td>Introductory Physical Chemistry I (CHEM 301)</td>
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<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 307)</td>
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<tr>
<td>SAGES University Seminar II</td>
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<tr>
<td>GER Course</td>
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<td>Introductory Physical Chemistry II (CHEM 302)</td>
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<td>Molecular Biology (BIOC 308)</td>
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<td>Introduction to Modern Physics (PHYS 221)</td>
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<td>Research Project (BIOC 391)</td>
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#### Senior

<table>
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<tr>
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<tr>
<td>Proteins and Enzymes (BIOC 312)</td>
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<td>Biochemistry SAGES Seminar (BIOC 373)</td>
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<td>Research Project (BIOC 391)</td>
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<td>Structural Biology (BIOC 334)</td>
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<td>Senior Capstone Experience (BIOC 393)</td>
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<td>Statistics/Data Analysis Elective</td>
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<td>Computational Methods in Physics (PHYS 250)</td>
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<td>Basic Statistics for Engineering and Science Using R Programming (STAT 312R)</td>
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<td>Statistics for Experimenters (STAT 313) (or equiv) Electives</td>
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**Total Units in Sequence: 126-146**

Note: At least the 3 credits of undergraduate research, BIOC 391 Research Project, is a prerequisite to the Capstone. An additional 3 credits of BIOC 391 is highly recommended. Students should consult their academic advisers about the elective parts of the curriculum.

a Selected students may be invited to take CHEM 323 Organic Chemistry I, CHEM 324 Organic Chemistry II.

b Selected students may be invited to take PHYS 123 Physics and Frontiers I - Mechanics, PHYS 124 Physics and Frontiers II - Electricity and Magnetism in place of PHYS 121 General Physics I - Mechanics, PHYS 122 General Physics II - Electricity and Magnetism.

### Honors Program

Biochemistry majors who have excellent academic records may be admitted to the department's Undergraduate Honors Program. To graduate with departmental honors in biochemistry, a student must satisfy the following requirements:

1. A combined grade point average of at least 3.600
2. A minimum of 6 credit hours of undergraduate research (BIOC 391) in one laboratory
3. A BIOC 393 capstone report approved by the Undergraduate Education Committee of the department on the basis of the quality of the research, the written report, and an oral presentation. An acceptable report:
   a. Should follow a standard journal format
   b. Should demonstrate the student’s understanding of the research area, experimental techniques, goals and implications of the project
   c. Should show that the student has advanced his/her knowledge of the applicable techniques and the underlying scientific concepts.

4. Using all or part of the capstone report, the student must be a co-author on a manuscript either submitted, in press or published in a peer reviewed journal.

**Minor**

Required Courses:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
<td>4</td>
</tr>
<tr>
<td>BIOC 308</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>One of the following:</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>BIOC 312</td>
<td>Proteins and Enzymes</td>
<td></td>
</tr>
<tr>
<td>BIOC 334</td>
<td>Structural Biology</td>
<td></td>
</tr>
<tr>
<td>Approved technical elective in biochemistry</td>
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</tbody>
</table>

Total Units 14

Students may obtain credit for a minor in biochemistry by completing one year of freshman chemistry (including laboratory), one year of organic chemistry (including laboratory), two semesters of approved biology courses, and three semesters of didactic courses in biochemistry.

**Masters Degrees**

The Biochemistry Department offers four Masters degrees. The three-year Masters of Science in Biochemical Research provides training in laboratory research. The two-year Masters of Science in Biochemistry provides students with advanced study in biochemistry and related fields. Two other programs provide advanced study in biochemistry in conjunction with degrees in medicine (MD/MS) and law (JD/MS).

Prerequisites for admission into any of the Biochemistry Graduate Programs are one year each of chemistry, organic chemistry, calculus, biology and physics. Applicants must also have a BA, BS or equivalent undergraduate degree. As part of the application process, students are required to take the Graduate Record Examination. Some students with otherwise excellent qualifications, but lacking some of the prerequisites may be conditionally admitted and allowed to make up the deficiencies. Students with advanced training (coursework, laboratory research, MS degree, etc.) may be given advanced standing. Please visit the Department’s web page (http://www.cwru.edu/med/biochemistry) for details about the application process.

**MS Biochemical Research**

The program leading to the MS degree in biochemical research is uniquely designed to provide students with sufficient background and laboratory experience to enable them to work as senior research assistants and eventually as laboratory supervisors in university departments, research institutes, or industrial laboratories. The students pursue flexible and individually designed schedules, which prepare them for independent research projects in the second and third years of the program. The program simultaneously develops background knowledge and technical skills in modern biochemistry, which can be applied to several career paths. A more complete description of the program is available from the departmental office.

The duration of the MSBR program is 33 months. Applicants who have been working as full time laboratory technicians may be granted 1 semester credit for one full year of work, and up to 2 semesters credit for two or more years of work. Credit for acceptable didactic coursework may be awarded up to a total of 14 hours. All decisions concerning advanced standing or transfer of credit will be made by the Graduate Education Committee following acceptance into the program and in consultation with the advisor. Courses taken to satisfy other degree requirements (i.e. BA or BS) may not be transferred for credit. A maximum of 6 hours can be transferred toward the course requirements, as set by the Graduate School. The program shall not be extended on the basis of work that needs to be completed in order to achieve a publishable result.

The degree follows Plan A for the Master’s degree. The program requires 36 hours of academic credit (including both research and didactic courses) as well as the writing and defense of a thesis. All courses must be at the 400 level or higher. The course credits include didactic courses (minimum of 12 hours of graded coursework), research (BIOC 601 Biochemical Research) and (BIOC 651 Thesis M.S.). BIOC 651 Thesis M.S. is taken only in the second and third years and requires an examination by the student’s pre-thesis committee and a written thesis. The student’s transcript will be annotated M.S. in Biochemical Research, including the title of the student’s independent project.

Prior to the student’s matriculation, she/he chooses an academic advisor. In general the selection process involves communication with those faculty members who have announced their interest in taking a Master’s student. In some cases the student may be invited to spend up to a week in the prospective advisor’s laboratory to facilitate the decision making process. In the early spring of the first year, pre-thesis committee of three faculty members (at least two of whom must be members of the Biochemistry faculty) is chosen by the student, in consultation with the advisor. In yearly meetings, this committee provides additional scientific expertise, offers support in overcoming research difficulties and evaluates the student’s progress in research and course work.

**MS Biochemical Research Plan of Study**

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<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Fall</td>
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<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 407)</td>
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<tr>
<td>BIOC elective</td>
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<tr>
<td>Molecular Biology (BIOC 408)</td>
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<td>Year Total:</td>
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<table>
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<th>Second Year</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
</tr>
<tr>
<td>Proteins and Enzymes (BIOC 412)</td>
<td>3</td>
</tr>
<tr>
<td>Biochemical Research (BIOC 601)</td>
<td>3</td>
</tr>
<tr>
<td>Structural Biology (BIOC 434)</td>
<td></td>
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</tbody>
</table>
Biochemical Research (BIOC 601) | 4
Master’s Comprehensive Exam (EXAM 600) | 1
Year Total: | 6

Total Units in Sequence: 28

**MS Biochemistry**

The program leading to the MS degree in biochemistry is designed to provide students with knowledge of the latest advancements in biochemistry and related fields. It is intended for students who desire to pursue a career not directly involved with research, such as teaching, or administrative positions in the biotechnology or pharmaceutical industries or to advance to other degree programs. Students typically enroll in three courses for each of four semesters.

The duration of the MSB program is 21 months; it follows the Plan B for the Master’s degree (p. 1045). The advisor for this program is usually the Graduate Advisor, but another advisor may be selected. The student’s progress is monitored by the Biochemistry Graduate Advisor and by the Graduate Education Committee. The program requires 36 hours of academic credit of which 18 hours must be graded coursework. Although this is a “coursework Masters degree,” students in the program often take 6 to 12 hours of BIOC 601 (Biochemical Research) as part of their requirements. All courses must be at the 400 level; they must be on the list of approved electives, or be approved by the advisor.

**MS Biochemistry Plan of Study**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Introduction to Biochemistry: From Molecules To Medical Science (BIOC 407)</td>
<td>4 Fall 4 Spring</td>
</tr>
<tr>
<td>BIOC elective</td>
<td>3</td>
</tr>
<tr>
<td>Molecular Biology (BIOC 408)</td>
<td>4</td>
</tr>
<tr>
<td>BIOC elective</td>
<td>3</td>
</tr>
<tr>
<td>Year Total:</td>
<td>7 Fall 7 Spring</td>
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<table>
<thead>
<tr>
<th>Second Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteins and Enzymes (BIOC 412)</td>
<td>3 Fall 3 Spring</td>
</tr>
<tr>
<td>BIOC elective</td>
<td>3</td>
</tr>
<tr>
<td>Structural Biology (BIOC 434)</td>
<td>3</td>
</tr>
<tr>
<td>BIOC elective</td>
<td>4</td>
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<tr>
<td>Master’s Comprehensive Exam (EXAM 600)</td>
<td>1</td>
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<tr>
<td>Year Total:</td>
<td>6 Fall 6 Spring</td>
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Total Units in Sequence: 28

**MD/MS Biomedical Investigation-Biochemistry Track**

The joint MD/MS program combine type (p. 1045) B MS programs (p. 1045) at the School of Medicine with the MD, using a common template. The core activities for this degree include limited credit from the medical core curriculum, 3-6 graduate courses in specific tracks, participation in a common seminar series, scientific integrity training, and a requirement for a special problems project that reflects a full year of research (18 hours of 601 non-graded credits) culminating in a written report and examination. This program will require 5 years overall to complete the requirements for both degrees. Students who wish to join the MD/MS program may apply to the Program after arriving at the University any time prior to Fall of their second year of medical school. For more information, please see MD Dual Degrees (p. 724).

The Biochemistry track is designed to provide students with knowledge of the latest advances in biochemistry and related fields. It is also appreciated that a number of courses offered by other departments may be considered “biochemistry” in the broader sense. Depending on the research project, it may be appropriate for the student to substitute one of the courses below in lieu of one of the biochemistry electives. Should this be the case, the student must receive permission from the Graduate Program Advisor for this substitution prior to registering for the course.

Students in the Biochemistry track must complete:

- IBIS 401 Integrated Biological Sciences I 3
- IBIS 402 Integrated Biological Sciences II 3
- BIOC 412 Proteins and Enzymes 3
- IBIS 402 Structural Biology 3
- Electives in Biochemistry (graded) 6
- BIOC 601 Biochemical Research 18
- IBMS 500 On Being a Professional Scientist: The Responsible Conduct of Research 1
- IBIS 600 Exam in Biomedical Investigation 0

**JD/MS in Biochemistry**

This program allows students admitted to the School of Law an opportunity to pursue a master of science degree in Biochemistry as part of an additional year of study. Such training adds expertise to students who anticipate careers in patent law or in areas related to biotechnology or pharmaceutical research. Please see the separate listing in the publication materials provided by the School of Law on this program.

Entrance into this program is achieved first by acceptance into the CWRU School of Law. Upon acceptance, students can then apply to the Biochemistry program for admission into the JD/MS program. As a result of participating in the dual degree program, students complete 12 fewer hours of law school coursework than they would if they were in the JD program alone. The Department of Biochemistry accepts 9 hours of law school coursework in courses dealing with science issues, in place of 9 credits of other elective work. Thus, the student will take a total of 27 hours of Biochemistry coursework of which at least 12 hours must be letter graded.

Dual degree students are advised concerning matters related to the JD degree by the Associate Dean for Academic Affairs at the School of Law. In addition, dual degree students are granted priority registration for upper level courses, ensuring that they will be able to accommodate their scheduling needs in obtaining required classes. Dual degree students are advised concerning matters related to the MS in Biochemistry by a JD/ MS Advisor as designated by the Graduate Education Committee of the Department of Biochemistry.

**JD/MS in Biochemistry (plan B (p. 1045))**
PhD Biochemistry

The aim of the PhD in biochemistry program is to prepare students for careers in biochemistry. The emphasis of the doctoral program is on research, culminating in the completion of an original independent research project under the guidance of a faculty member in the biochemistry program. In addition to the research activities, graduate students participate in formal courses both within and outside the department, formal and informal seminars, discussions of current literature, and career development activities. Although students choose from the various tracks within the department, all are broadly trained in modern aspects of biochemistry and become familiar with techniques and literature in a variety of areas. Many collaborative projects with other departments also are available to broaden the spectrum of training offered. Most students begin with an integrated curriculum in cellular and molecular biology in addition to specialized courses in biochemistry. Students are admitted to the Biochemistry PhD program through the Biomedical Sciences Training Program (BSTP) (http://casemed.case.edu/bstp) or via the Medical Scientist Training Program (MSTP) (http://mstp.case.edu/default.asp). The BSTP offers a common entry point to most of our biomedical PhD programs. The MSTP is available for students desiring the dual MD/PhD degrees and research careers in medicine and related biosciences.

Prerequisites for admission into the Biochemistry PhD Program include one year each of chemistry, organic chemistry, calculus, biology and physics. Applicants must also have a BA, BS or equivalent undergraduate degree. Students must submit scores from the Graduate Record Examination and may submit scores from an advanced area test, usually in biology, biochemistry or chemistry. Some students with otherwise excellent qualifications, but lacking some of the prerequisites may be conditionally admitted allowed to make up the deficiencies. Please visit the Department’s web page (http://www.cwru.edu/med/biochemistry) for details about the application process.

To earn a PhD in Biochemistry, a student must complete rotations in at least three laboratories, followed by selection of a research advisor, and complete core and elective coursework, including Responsible Conduct of Research, as described in the Course of Study below. Students who have completed relevant coursework elsewhere, (for example, with a MS) may petition to complete alternative courses.

In addition, each PhD student must successfully complete a qualifying examination in the form of a short grant proposal with oral defense for advancement to candidacy. The qualifying examination is usually completed during the second year. During the dissertation period, students are expected to meet twice a year with their thesis committees, present seminars in the department, and fulfill journal publication requirements. Throughout the doctoral training, students are expected to be enthusiastic participants in seminars, journal clubs, and research meetings in the lab and program. Completion of the PhD degree requires 36 hours of coursework (24 hours of which are graded) and 18 hours of BIO 701 Dissertation Ph.D.

PhD Biochemistry Plan of Study

§ Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045)

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Total Units in Sequence: 57-89
Courses

**BIOC 307. Introduction to Biochemistry: From Molecules To Medical Science. 4 Units.**
Overview of the macromolecules and small molecules key to all living systems. Topics include: protein structure and function; enzyme mechanisms, kinetics and regulation; membrane structure and function; bioenergetics; hormone action; intermediary metabolism, including pathways and regulation of carbohydrate, lipid, amino acid, and nucleotide biosynthesis and breakdown. The material is presented to build links to human biology and human disease. One semester of biology is recommended. Offered as BIOC 307, BIOC 407, and BIOL 407. Prereq: CHEM 223 and CHEM 224.

**BIOC 308. Molecular Biology. 4 Units.**
An examination of the flow of genetic information from DNA to RNA to protein. Topics include: nucleic acid structure; mechanisms and control of DNA, RNA, and protein biosynthesis; recombinant DNA; and mRNA processing and modification. Where possible, eukaryotic and prokaryotic systems are compared. Special topics include yeast as a model organism, molecular biology of cancer, and molecular biology of the cell cycle. Current literature is discussed briefly as an introduction to techniques of genetic engineering. Recommended preparation: BIOC 307. Offered as BIOC 308, BIOL 308, BIOC 408, and BIOL 408. Prereq: CHEM 223, BIOL 214, and BIOL 215.

**BIOC 312. Proteins and Enzymes. 3 Units.**
Aspects of protein and nucleic acid function and interactions are discussed, including binding properties, protein-nucleic acid interactions, kinetics and mechanism of proteins and enzymes, and macromolecular machines. Recommended Preparation: CHEM 301. Offered as BIOC 312 and BIOC 412. Prereq: BIOC 307.

**BIOC 315. Nuclear Receptors in Health and Disease. 3 Units.**
This course focuses on hormone-gene interactions mediated by the ligand-inducible transcription factors termed nuclear hormone receptors. The class will address the mechanisms of action, regulatory features, and biological activities of several nuclear receptors. The usage of nuclear receptors as therapeutic targets in disease states such as cancer, inflammation, and diabetes will also be discussed. The course aims to teach students to critically evaluate primary literature relevant to nuclear hormone receptors biology, and to reinforce presentation/discussion skills. Grades for undergraduates will be based on midterm, final exam; grades for graduates will be based on midterm, final exam, and presentation of a recently published research article related to the role of nuclear receptors in health and disease. Offered as PHRM 315, BIOC 315, PHRM 415 and BIOC 415.

**BIOC 334. Structural Biology. 3 Units.**
Introduces basic chemical properties of proteins and discusses the physical forces that determine protein structure. Topics include: the elucidation of protein structure by NMR and by X-ray crystallographic methods; the acquisition of protein structures from data bases; and simple modeling experiments based on protein structures. Offered as BIOC 334, BIOL 334, BIOC 434, and BIOL 434. Prereq: BIOC 307.

**BIOC 354. Biochemistry and Biology of RNA. 3 Units.**
Systematic overview of RNA biochemistry and biology. Course provides solid foundation for understanding processes of post-transcriptional regulation of gene expression. Topics include: RNA structure, RNA types, RNA-protein interactions, eukaryotic RNA metabolism including mRNA processing, ribosome biogenesis, tRNA metabolism, miRNA processing and function, bacterial RNA metabolism, transcriptomics. BIOC 454 requires an additional research proposal. Recommended preparation for BIOC 354: Undergraduate Biology (1 semester minimum), equivalents of CHEM 301, BIOC 307 or BIOC 308, CHEM 223, CHEM 224. Offered as BIOC 354 and BIOC 454. Prereq: CHEM 223, CHEM 224.

**BIOC 373. Biochemistry SAGES Seminar. 3 Units.**
Discussion of current topics in biochemical research using readings from the scientific literature. The goals are for the student: 1) to discuss and critically analyze selections from the biochemical literature; 2) to gain a broader understanding of important topics not formally covered in the didactic courses; and 3) to learn to write in the style of journals in the field of biochemistry. Counts as SAGES Departmental Seminar. Prereq: BIOC 307 and BIOC 308. Restricted to majors in Biochemistry.

**BIOC 391. Research Project. 1 - 9 Units.**
(Credit as arranged.) Offered on a pass/fail basis only. Maximum 9 hours total credit.

**BIOC 393. Senior Capstone Experience. 3 Units.**
Students will complete their Capstone Projects, begun in BIOC 391. Pertinent research activities will depend on the nature of the student's project. The student will meet regularly with their Capstone adviser, at least twice monthly, to provide progress reports, discuss the project, and for critique and guidance. By the end of this course, the student will have completed their SAGES Senior Capstone research project, written a project report in the form of a manuscript, and presented their project reports orally in the department and at the Senior Capstone Fair, or its equivalent. Counts as SAGES Senior Capstone. Prereq: BIOC 307 and BIOC 308.

**BIOC 405. Principles of Biochemistry: An Introduction to the Molecules of Life. 3 Units.**
This summer course provides an introduction to the macromolecules and small molecules that are the foundation of living systems. The focus is on mammalian biochemistry, with links to human biology and human disease. Topics include: protein structure and function; enzyme mechanisms, kinetics and regulation; membranes; hormone action; bioenergetics; intermediary metabolism, including pathways and regulation of carbohydrate, lipid, amino acid, and nucleotide biosynthesis and breakdown. One semester of biology is recommended. Suitable for students interested in careers in the health professions. This course is not open to undergraduate Biochemistry majors or Biochemistry graduate students. Prereq: CHEM 223 and CHEM 224.

**BIOC 407. Introduction to Biochemistry: From Molecules To Medical Science. 4 Units.**
Overview of the macromolecules and small molecules key to all living systems. Topics include: protein structure and function; enzyme mechanisms, kinetics and regulation; membrane structure and function; bioenergetics; hormone action; intermediary metabolism, including pathways and regulation of carbohydrate, lipid, amino acid, and nucleotide biosynthesis and breakdown. The material is presented to build links to human biology and human disease. One semester of biology is recommended. Offered as BIOC 307, BIOC 407, and BIOL 407. Prereq: CHEM 223 and CHEM 224.
BIOC 408. Molecular Biology. 4 Units.
An examination of the flow of genetic information from DNA to RNA to protein. Topics include: nucleic acid structure; mechanisms and control of DNA, RNA, and protein biosynthesis; recombinant DNA; and mRNA processing and modification. Where possible, eukaryotic and prokaryotic systems are compared. Special topics include yeast as a model organism, molecular biology of cancer, and molecular biology of the cell cycle. Current literature is discussed briefly as an introduction to techniques of genetic engineering. Recommended preparation: BIOC 307. Offered as BIOC 308, BIOL 308, BIOC 408, and BIOL 408.

BIOC 412. Proteins and Enzymes. 3 Units.
Aspects of protein and nucleic acid function and interactions are discussed, including binding properties, protein-nucleic acid interactions, kinetics and mechanism of proteins and enzymes, and macromolecular machines. Recommended Preparation: CHEM 301. Offered as BIOC 312 and BIOC 412.

BIOC 415. Nuclear Receptors in Health and Disease. 3 Units.
This course focuses on hormone-gene interactions mediated by the ligand-inducible transcription factors termed nuclear hormone receptors. The class will address the mechanisms of action, regulatory features, and biological activities of several nuclear receptors. The usage of nuclear receptors as therapeutic targets in disease states such as cancer, inflammation, and diabetes will also be discussed. The course aims to teach students to critically evaluate primary literature relevant to nuclear hormone receptors biology, and to reinforce presentation/discussion skills. Grades for undergraduates will be based on midterm, final exam; grades for graduates will be based on midterm, final exam, and presentation of a recently published research article related to the role of nuclear receptors in health and disease. Offered as PHRM 315, BIOC 315, PHRM 415 and BIOC 415.

BIOC 420. Current Topics in Cancer. 3 Units.
The concept of cancer hallmarks has provided a useful guiding principle in our understanding of the complexity of cancer. The hallmarks include sustaining proliferative signaling, evading growth suppressors, enabling replicative immortality, activating invasion and metastasis, inducing angiogenesis, resisting cell death, deregulating cellular energetics, avoiding immune destruction, tumor-promoting inflammation, and genome instability and mutation. The objectives of this course are to (1) examine the principles of some of these hallmarks, and (2) explore potential therapies developed based on these hallmarks of cancer. This is a student-driven and discussion-based graduate course. Students should have had some background on the related subjects and have read scientific papers in their prior coursework. Students will be called on to present and discuss experimental design, data and conclusions from assigned publications. There will be no exams or comprehensive papers but students will submit a one-page critique (strengths and weaknesses) of one of the assigned papers prior to each class meeting. The course will end with a full-day student-run symposium on topics to be decided jointly by students and the course director. Grades will be based on class participation, written critiques, and symposium presentations. Offered as BIOC 420, MBIO 420, PATH 422, and PHRM 420. Prereq: CBIO 453 and CBIO 455.

BIOC 430. Advanced Methods in Structural Biology. 1 - 6 Units.
The course is designed for graduate students who will be focusing on one or more methods of structural biology in their thesis project. This course is divided into 3-6 sections (depending on demand). The topics offered will include X-ray crystallography, nuclear magnetic resonance spectroscopy, optical spectroscopy, mass spectrometry, cryo-electron microscopy, and computational and design methods. Students can select one or more modules. Modules will be scheduled so that students can take all the offered modules in one semester. Each section is given in 5 weeks and is worth 1 credit. Each section covers one area of structural biology at an advanced level such that the student is prepared for graduate level research in that topic. Offered as BIOC 430, CHEM 430, PHOL 430, and PHRM 430.

BIOC 432. Current Topics in Vision Research. 3 Units.
Vision research is an exciting and multidisciplinary area that draws on the disciplines of biochemistry, genetics, molecular biology, structural biology, neuroscience, and pathology. This graduate level course will provide the student with broad exposure to the most recent and relevant research currently being conducted in the field. Topics will cover a variety of diseases and fundamental biological processes occurring in the eye. Regions of the eye that will be discussed include the cornea, lens, and retina. Vision disorders discussed include age-related macular degeneration, retinal opacities, and diabetic retinopathy. Instructors in the course are experts in their field and are members of the multidisciplinary visual sciences research community here at Case Western Reserve University. Students will be exposed to the experimental approaches and instrumentation currently being used in the laboratory and in clinical settings. Topics will be covered by traditional lectures, demonstrations in the laboratory and the clinic, and journal club presentations. Students will be graded on their performance in journal club presentations (40%), research proposal (40%), and class participation (20%). Offered as NEUR 432, PATH 432, PHRM 432 and BIOC 432.

BIOC 434. Structural Biology. 3 Units.
Introduces basic chemical properties of proteins and discusses the physical forces that determine protein structure. Topics include: the elucidation of protein structure by NMR and by X-ray crystallographic methods; the acquisition of protein structures from data bases; and simple modeling experiments based on protein structures. Offered as BIOC 334, BIOL 334, BIOC 434, and BIOL 434.

BIOC 452. Nutritional Biochemistry and Metabolism. 3 Units.
Mechanisms of regulation of pathways of intermediary metabolism; amplification of biochemical signals; substrate cycling and use of radioactive and stable isotopes to measure metabolic rates. Recommended preparation: BIOC 307 or equivalent. Offered as BIOC 452 and NTRN 452.

BIOC 454. Biochemistry and Biology of RNA. 3 Units.
Systematic overview of RNA biochemistry and biology. Course provides solid foundation for understanding processes of post-transcriptional regulation of gene expression. Topics include: RNA structure, RNA types, RNA-protein interactions, eukaryotic RNA metabolism including mRNA processing, ribosome biogenesis, tRNA metabolism, miRNA processing and function, bacterial RNA metabolism, transcriptomics. BIOC 454 requires an additional research proposal. Recommended preparation for BIOC 354: Undergraduate Biology (1 semester minimum), equivalents of CHEM 301, BIOC 307 or BIOC 308, CHEM 223, CHEM 224. Offered as BIOC 354 and BIOC 454.
BIOC 460. Introduction to Microarrays. 3 Units.
Microarray technology is an exciting new technique that is used to analyze gene expression in a wide variety of organisms. The goal of this course is to give participants a hands-on introduction to this technology. The course is intended for individuals who are preparing to use this technique, including students, fellows, and other investigators. This is a hands-on computer-based course, which will enable participants to conduct meaningful analyses of microarray data. Participants will gain an understanding of the principles underlying microarray technologies, including: theory of sample preparation, sample processing on microarrays, familiarity with the use of Affymetrix Microarray Suite software and generation of data sets. Transferring data among software packages to manipulate data will also be discussed. Importation of data into other software (GeneSpring and DecisionSite) will enable participants to mine the data for higher-order patterns. Participants will learn about the rationale behind the choice of normalization and data filtering strategies, distance metrics, use of appropriate clustering choices such as K-means, Hierarchical, and Self Organizing Maps. Offered as BIOC 460, PATH 460 and CNCR 460. Prereq: CBIO 455.

BIOC 475. Protein Biophysics. 3 Units.
This course focuses on in-depth understanding of the molecular biophysics of proteins. Structural, thermodynamic and kinetic aspects of protein function and structure-function relationships will be considered at the advanced conceptual level. The application of these theoretical frameworks will be illustrated with examples from the literature and integration of biophysical knowledge with description at the cellular and systems level. The format consists of lectures, problem sets, and student presentations. A special emphasis will be placed on discussion of original publications. Offered as BIOC 475, CHEM 475, PHOL 475, PHRM 475, and NEUR 475.

BIOC 519. Molecular Biology of RNA. 3 Units.
Selected topics regarding editing, enzymatic function, splicing, and structure of RNA. Offered as BIOC 519, CLBY 519, and MBIO 519.

BIOC 528. Contemporary Approaches to Drug Discovery. 3 Units.
This course is designed to teach the students how lead compounds are discovered, optimized, and processed through clinical trials for FDA approval. Topics will include: medicinal chemistry, parallel synthesis, drug delivery and devices, drug administration and pharmacokinetics, and clinical trials. A special emphasis will be placed on describing how structural biology is used for in silico screening and lead optimization. This component will include hands-on experience in using sophisticated drug discovery software to conduct in silico screening and the development of drug libraries. Each student will conduct a course project involving in silico screening and lead optimization against known drug targets, followed by the drafting of an inventory disclosure. Another important aspect of this course will be inclusion of guest lectures by industrial leaders who describe examples of success stories of drug development. Offered as BIOC 528, PHOL 528, PHRM 528, and SYBB 528.

BIOC 599. RNA Structure and Function. 3 Units.
This course will cover fundamental aspects of modern RNA biology with emphasis on the interplay of three dimensional structure of nucleic acids and their function. The main focus of the course is on the recent discoveries that indicate a prominent role of RNA as a major regulator of cellular function. Topics discussed will include an introduction to RNA structure, folding and dynamics, RNA/RNA and RNA-protein interactions, and role of RNA in catalysis of biological reactions in ribosome and the role of other catalytic RNAs in RNA biogenesis, pre-mRNA splicing, and viral replication. The course also covers the recently discovered RNA regulatory switches, large noncoding regulatory RNAs, and the role of RNA in human diseases and novel, RNA-based therapeutics. Offered as BIOC 599, CLBY 599, and MBIO 599.

BIOC 601. Biochemical Research. 1 - 18 Units.
Credit as arranged.

BIOC 611. Biochemistry Seminar I. 1 Unit.
Student presentations of topics from the current scientific literature unrelated to the student’s research project. Participants are required to present a seminar.

BIOC 612. Biochemistry Seminar II. 1 Unit.
Discussion of current research.

BIOC 641. Proposition I. 2 Units.
Design of research proposal.

BIOC 651. Thesis M.S.. 1 - 6 Units.
(Credit as arranged.)

BIOC 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Bioethics

Room TA-200, School of Medicine
http://www.case.edu/med/bioethics/bioethics.html
Phone: 216.368.8718
Mark P. Aulisio, PhD, Susan E. Watson Professor and Chair
mark.aulisio@case.edu

Marie Norris (marie.norris@case.edu), Program Assistant

The mission of the Department of Bioethics is to improve public and professional understanding of the ethical and contextual issues involved in health sciences research, health care delivery, and health policy development through teaching, research and community dialogue.

The department has offices at the Case’s School of Medicine and at MetroHealth Medical Center and has faculty from multiple disciplines, including philosophy, religion, law, political science, anthropology, history, sociology, psychology, nursing and medicine.

Department faculty teach in both core and elective components of the medical school curriculum, undergraduate courses in ethics and medical humanities, and an intensive course in responsible conduct of research for PhD students in the School of Medicine. The department also has a highly successful master’s degree program in bioethics and an undergraduate minor

Department faculty have gained international prominence for research in many areas of biomedical ethics and medical humanities that collectively address the concerns of the School of Medicine’s spectrum of biomedical disciplines and questions of health more broadly.
Please visit the department website (http://www.case.edu/med/bioethics) to obtain information about the Master’s degree program and learn about department and faculty activities.

**Minor in Bioethics and Medical Humanities**

Bioethics and Medical Humanities together comprise a vibrant area of scholarship concerning the most important and cutting-edge ethical issues surrounding biomedical research and the delivery of health care today. The study of such ethical issues calls into action our most central human values and related behaviors, the exploration of which is of crucial importance for all students whether one plans to enter a career in the healthcare professions, biomedical research, law, nonprofit administration, or some other career path. The topics covered in Bioethics and Medical Humanities will help prepare students to become responsible world citizens in an increasingly complex biomedical environment.

The CWRU Minor in Bioethics and Medical Humanities formally recognizes a student’s coordinated course of study comprised of courses currently offered by the Department of Bioethics and other departments in the College of Arts and Sciences. The Bioethics and Medical Humanities Minor is designed to give students ethical and social training centered specifically around the delivery of health care and medical humanities, and the underlying philosophical arguments and empirical assumptions that inform these areas. Students are taught to understand the institutions, structures and contexts of health care and biomedical research, and to do so in a highly interdisciplinary manner.

**Plan of Study**

I. Students should select three of the following four course offerings. (9 credit hours)

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<td>Perspectives on Health: Introduction to Medical Humanities and Social Medicine</td>
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<td>BETH 271</td>
<td>Bioethics: Dilemmas</td>
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<td>BETH 360</td>
<td>Science and Society</td>
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<tr>
<td>BETH 371</td>
<td>Advanced Bioethics</td>
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II. ELECTIVE COURSES (6 Credit Hours)

Additional Courses may be added in the future to this list of electives. Each new elective course must be approved by Bioethics Department faculty director of the Minor and must have substantial bioethics or medical humanities content (greater than 75%).

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<td>International Bioethics: Policy and Practice</td>
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<td>BETH 371C</td>
<td>Advanced Bioethics: Clinical Observation</td>
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<td>BETH 406</td>
<td>Society, Religion, and Bioethics</td>
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<td>Writing for the Health Professions</td>
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<td>ENGL 330</td>
<td>Victorian Literature</td>
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<td>ENGL 341</td>
<td>Rhetoric of Science and Medicine</td>
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<td>Topics in Language Studies</td>
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<td>HSTY 241</td>
<td>Inventing Public Health</td>
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### Master of Arts in Bioethics Degree

The Department of Bioethics offers a program leading to the Master of Arts degree in bioethics, emphasizing the interdisciplinary and inter-professional nature of the field. This graduate program is designed to provide advanced training in bioethics and medical humanities for students and professionals who anticipate encountering ethical issues in the course of their primary careers.

The Master of Arts program provides students with a firm understanding of the intellectual content of the study of bioethics, bioethical literature, medical humanities, and the underlying philosophical arguments and empirical assumptions that inform these areas. Students are taught to understand the institutions, structures and contexts of health care and the ethical issues that arise in medical practice. They are trained to identify and analyze a range of clinical ethics issues.

All students pursuing a Master of Arts degree in bioethics are required to complete the interdisciplinary core of 12 credit hours (the equivalent of four courses) in the first two semesters of their first year of study.

### MA Bioethics Plan of Study

#### First Year

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<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>BETH 315</td>
<td>International Bioethics: Policy and Practice</td>
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<td>BETH 371C</td>
<td>Advanced Bioethics: Clinical Observation</td>
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<td>BETH 406</td>
<td>Society, Religion, and Bioethics</td>
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<td>ENGL 217B</td>
<td>Writing for the Health Professions</td>
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<td>ENGL 330</td>
<td>Victorian Literature</td>
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<td>ENGL 341</td>
<td>Rhetoric of Science and Medicine</td>
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<td>Topics in Language Studies</td>
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<td>ENGL 386</td>
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<td>HSTY 151</td>
<td>Technology in European Civilization</td>
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<td>HSTY 241</td>
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<td>Guns, Germs, and Steel</td>
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<td>Women and Medicine in the United States</td>
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<td>HSTY 395</td>
<td>History of Medicine</td>
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<td>Clinical Ethics Rotation (BETH 405)</td>
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#### Year Total:

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#### Total Units in Sequence:

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MS/MA in Genetic Counseling and Bioethics (plan B)

The Departments of Genetics & Genome Sciences and Bioethics offer a dual degree program between the Masters in Genetic Counseling and the Masters in Bioethics Programs. The dual degree program provides a comprehensive curriculum integrating foundational principles of genetics and ethics. The goal of the program is to train Genetic Counselors who wish to apply additional Bioethics expertise into their clinical practice and/or research.

The dual degree program allows graduates to engage in both contemplative analysis and application of knowledge in the counseling of patients and should allow graduates to be more prepared to participate in the ongoing national dialogue about the ethical, legal, and social implications of advances in genomic technology as well as research within their home institutions and with other counselors nationwide regarding issues of new genomic testing technology, concerns about genetic services, and issues related to genetic discrimination, privacy, and the return of genetic and genomic results.

The curriculum for the Dual Genetic Counseling/Bioethics Degree consists of 59 credit hours to be completed in 2.5 years. Students enrolled in the dual degree program will spend their first year taking courses entirely within the Genetic Counseling Program and then will spread out their Bioethics coursework over the next 1.5 years while continuing with required coursework and clinical rotations in the genetic counseling program.

In addition to both a written and oral comprehensive examination as part of the Genetic Counseling Training Program, the dual degree requires a research project be carried out for the completion of the both degrees. For the dual degree, students will be required to choose a research project that includes ethical, legal, or social issues of genetic counseling practice, clinical genetics or genomics, or genetic research. Students will also be required to include at least one Bioethics Faculty member on their Research Project Committee.

Students who would like to enroll in the dual degree program will apply and be admitted into each program separately. While admissions committees for each program will communicate with each other regarding applicants, each admissions committee will decide independently about the suitability of the applicant to their program.

Once students have been admitted, the Director of the Genetic Counseling Training Program and the Director of the MA Program in Bioethics will be act as student advisors for each of the two programs individually but will meet monthly to assess student progress, address any student or faculty concerns, and assure that student progress in each of the programs, and their overlapping components, are being achieved.

MS/MA Plan of Study

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<th>First Year</th>
<th>Fall</th>
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<td>Advanced Medical Genetics: Molecular &amp; Cytogenetics (GENE 524)</td>
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Total Units in Sequence: 59

Courses

BETH 210. Perspectives on Health: Introduction to Medical Humanities and Social Medicine. 3 Units.

This survey course is designed to give students a broad overview of medical humanities and medical social sciences. Students will engage materials from a wide range of disciplines and learn how to analyze which perspectives afford and obscure which types of knowledge relevant to health, illness and clinical practice. Students will learn how to identify epistemology, methodology, theory and data from various disciplinary perspectives. This course is relevant for students engaged in pre-clinical education as well as those interested in medical humanities and medical social sciences.
BETH 271. Bioethics: Dilemmas. 3 Units.
We have the genetic technology to change nature and human nature, but should we? We have the medical technology to extend almost any human life, but is this always good? Should we clone humans? Should we allow doctor-assisted suicide for the terminally ill? This course invites students from all academic disciplines and fields to examine current and future issues in bioethics—e.g., theory and methods in bioethics; death and dying; organ transplantation; genetics; aging and dementia; fertility and reproduction; distributive justice in health care access. The course will include guest lectures from nationally-known Bioethics faculty. Offered as BETH 271 and PHIL 271.

BETH 314. Global Health: India. 3 Units.
Bioethics is the study of ethical controversies arising at the intersection of biology, medicine, technology, politics, law, philosophy, religion and culture. This course will discuss and analyze the issue of health in India; recognizing that health is more than the diagnosis and treatment of a disease. Using three diseases (HIV/AIDS, leprosy and tuberculosis) students will explore the relationship between culture and health care outcomes. Relevant issues addressed in the course include the history of British rule in India, Hinduism, the Caste system, poverty, access to education and public policy. Faculty will introduce readings on the history of India, medical anthropology, religion and the law. Students will then be given the opportunity to focus on a particular topic, research the existing literature, present their findings to the class and create a plan to observe the chosen topic while in India during the Summer semester. Course instructors include Nicole Deming, JD, MA Assistant Professor of Bioethics; Deepak Sarma, PhD, Associate Professor of South Asian Religions; and Gopal Yadavalli, MD Assistant Professor of Medicine and Chief of the Infectious Diseases Clinic at the Cleveland VA Medical Center. The course will also invite guest lectures from many different departments and schools to share their expertise and experience in the areas of Global Justice, Anthropology, and Human Rights.

BETH 315. International Bioethics: Policy and Practice. 3 Units.
Taught by Case and international faculty, this course will include 7-10 days of intensive didactic and experiential learning in one of several "host" countries. Examples of sites include: Free University of Amsterdam and University of Utrecht in the Netherlands; University of Paris in France; and Ben Gurion University in Israel. It will afford a unique opportunity to gain perspective on important bioethics issues in different societies, i.e., euthanasia, public health policies, access to healthcare, and stem cell research. At the international site, students will spend 6 hours per day (5 days) in seminar (involving didactics, discussion, and guided-observation clinical experience). There will be two 3-hour preparatory sessions, required reading, and two 3-hour post trip sessions. Requirements: preparation, attendance, and class participation, a 12-15 page paper (undergraduate credit) and a 15-20 page paper (graduate credit). Graduate credit will also require students to prepare a presentation for a post-intensive session. Enrollment will be capped at 25. This course has an additional fee to cover costs of travel and lodging. Limited scholarships are available. Offered as BETH 315 and BETH 415.

BETH 315A. International Bioethics Policy and Practice: Women's Health in the Netherlands. 3 Units.
This 3-credit course allows students to familiarize themselves with social policies and practices related to women's health in the United States and the Netherlands. Issues covered in the course include birth control and family planning, abortion, prenatal testing, childbirth, health care disparities, cosmetic surgery, prostitution and trafficking in women. This course also addresses the US and Dutch national policies regarding the public provision of health care for women. The course places an emphasis on the ways in which social norms shape policies over time, which political actors are involved in shaping women's health policy, and the balance between women's health as a matter of the public good or individual responsibility. This course substantively explores gender-specific cultural values and practices in relation to women's health in the United States and the Netherlands and will help students develop the analytical skills necessary for evaluating social policy and ethical issues related to women's health. Offered as BETH 315A and BETH 415A. Counts for CAS Global & Cultural Diversity Requirement.

BETH 315B. International Bioethics Policy and Practice: Public Health in the Netherlands. 3 Units.
This one week 3-credit intensive course will be held in Amsterdam, The Netherlands. Taught by faculty from Case and Utrecht University, this course offers students a cross-cultural perspective on ethical dilemmas raised by the practice of public health in the United States and Northern Europe. Additionally, this course examines policies related to prostitution, drug use, sex education, infectious disease prevention, and access to health care and how they differ in the cultural and political settings of U.S. and the Netherlands. We will examine both the rationales and outcomes of Dutch and American policies, stimulating course participants to consider their own views on these often controversial issues. Prior to the trip, students will attend lectures at Case, which will acquaint them with the theoretical approaches to public health ethics and major issues raised in the practice of public health. In these pre-trip sessions, students will also analyze and report on a case study designed to stimulate critical thinking on comparative public health ethics. In Amsterdam, students will attend lectures that will be supplemented by site visits and discussion sessions aimed at exploring the ethics of public health policy and practice in the Netherlands. Following the intensive week in Amsterdam, students will meet with instructors at Case for two hours to discuss their experiences and compare policies and practices in the U.S. and the Netherlands. Offered as BETH 315B and BETH 415B. Counts for CAS Global & Cultural Diversity Requirement.
BETH 315C. International Bioethics Policy and Practice: Health Care Cost Rica. 3 Units.
This 3-credit course gives students the unique opportunity to observe patients and practitioners encounter in a radically different health care system. Cost Rica has one of the most comprehensive health care systems in the Western hemisphere, featuring the innovative use of mid-level health care workers organized in basic comprehensive health care teams. This has resulted in a longer life expectancy than the United States, despite a per capita GDP of only $10,000 per person. Students will gain first-hand experience of Costa Rican health care through field experiences at sites including a national hospital in the capital city, San Jose; a peripheral treatment clinic in a smaller town; and observation of the work of an integrated basic health care team in an indigenous reserve. Following each visit, students will discuss the practical and ethical dilemmas that practitioners face in the context of the Costa Rican health care system. Specific topics include: health inequalities within and between nations; the ethics of transplantation, medical research, and end-of-life care; and health care in rural environments and with indigenous populations. Offered as BETH 315C and BETH 415C. Counts for CAS Global & Cultural Diversity Requirement.

BETH 315D. French Connections, A Cross-Cultural Comparison of Medical Ethics. 3 Units.
This 3-credit course is collaboration between Case Western Reserve University and the University of Paris. The course includes a ten-day trip to Paris, France over Spring Break. This course offers a cross-cultural comparison of the French and American medical systems. Students will have the unique opportunity to learn first-hand how the French medical education system is structured and how the social, cultural and political contexts in France shape medical and ethical issues. The trip includes guided field experiences in French clinical settings as well as opportunities to engage with French faculty members and physicians about contemporary issues in bioethics. Ethical issues that may be considered may include reproductive rights, decision-making involving severely impaired newborns, withholding/withdrawing life-sustaining treatment and issues in organ donation and transplant. The course also will also emphasize the role of French culture and history while in Paris with museum and site visits designed to complement seminar content and offer real-life illustrations of course content. Prior to the trip, students attend six hours of lectures, either at Case Western Reserve University or via a web-based tutorial. Students are expected to become familiar with the representative articles assigned for the course, and be prepared to integrate those readings into pre-trip class participation and active participation while in France. Following the trip, students meet with the instructor for an additional four hours to discuss and synthesize their experiences. Offered as BETH 315D and BETH 415D. Counts for CAS Global & Cultural Diversity Requirement.

BETH 315E. International Bioethics: Policy and Practice--US and Spanish Perspectives, Salamanca Spain. 3 Units.
This 3-credit hour course will introduce advanced undergraduate and graduate students to theoretical and practical aspects of bioethics in a European context. Continental health professionals and bioethicists work in an environment that differs from the American context in at least three important dimensions: the political structure of their health care systems, the cultural influence of their religious histories, and the theoretical perspective of continental moral philosophy. The University of Salamanca in Spain, one of the oldest universities in Europe (known as the "Oxford of Spain"), will be used in this course as a focal point for examining the interplay of these three dimensions in shaping institutional and professional approaches to specific problems in bioethics, including end of life decisions, organ procurement and allocation, reproductive ethics, health care justice, and environmental bioethics ("eco-ethics"). This course will help advanced students who are already grounded in American bioethics develop the analytical skills necessary for evaluating European bioethical scholarship and policy-making, while helping less advanced students develop a familiarity with fundamental similarities and differences between bioethics in Spain and the U.S. The course will include a one week trip to Salamanca, Spain where students will be taught by instructors and faculty from the University of Salamanca. Teaching will include some guided field experiences and regular discussion sessions with the course faculty. Prior to the trip, students will attend 4 hours of class at Case to become familiar with elements of political theory and moral philosophy relevant to the in-country discussions. Following the trip, students will meet with instructors for an additional 2 hours. Offered as BETH 315E and BETH 415E. Counts for CAS Global & Cultural Diversity Requirement.

BETH 315F. Bioethics Themes as Expressed in Spanish and American Culture: Film, Television, and Literature. 3 Units.
This 3-credit intensive course will be held in San Sebastian, Spain. Taught by faculty from CWRU and University of the Basque Country, this course offers students a cross-cultural perspective on bioethics in the United States and Spain. This course uses the medium of film, complemented by readings in bioethics, film criticism, and medical research, to introduce students to a number of compelling bioethics problems facing physician-scientists today, including: when life begins, the nature and limits of informed consent, use of randomization without equipoise, medical imperialism (or the appearance thereof), the treatment of so-called "orphan" diseases, use of deception in research, and financial conflicts of interests caused by among other things, the involvement of the pharmaceutical industry in the drug invention process. Offered as BETH 315F and BETH 415F. Counts for CAS Global & Cultural Diversity Requirement.
BETH 315G. Death, Dying & Euthanasia: Netherlands & the USA. 3 Units.
Is it ever permissible for physicians to kill their patients? In the Netherlands, the answer is yes. In the United States, it is no. Are the Dutch sliding down a moral slippery slope? Are the Americans compromising the rights and dignity of dying patients? This 3-credit course is a unique opportunity to examine a range of Dutch and American end-of-life policies and practices with special focus on the unique ethical, cultural, religious, and legal contexts in which they developed. This course will compare how two liberal democracies, the United States and the Netherlands, have handled difficult end-of-life issues, including: The Dutch regulation of euthanasia; Regulation of physician-assisted suicide in the state of Oregon; Terminal sedation; End-of-life decisions in newborns; Withholding and withdrawing of artificially-provided fluids and nutrition; The legal basis for end-of-life decision making in the USA; Palliative care and hospice; Public trust in medicine and physicians. In the United States, teaching methods will include lectures, case discussion, and exposure to how some of the course’s themes are reflected in popular culture such as movies. Offered as BETH 315G and BETH 415G. Counts for CAS Global & Cultural Diversity Requirement.

BETH 315H. Water Security and Social Justice in Brazil. 3 Units.
CWRU, through the Center for Global Health and Diseases, has had projects, student exchanges and courses with institutions in Brazil and especially with the state of Bahia for over 30 years. In that time, personal and professional relationships have been developed with branches of the Ministry of Health (Oswaldo Cruz Foundation, the Municipal and State Health Departments), the Federal University of Bahia, and the Bahiana School of Medicine and Public Health. Brazil is the second largest country in the Western Hemisphere and the 7th or 8th largest economy in the world. There are more people who speak Portuguese in South America than Spanish. Despite newly discovered oil, enormous natural and human resources, development in Brazil has been uneven with the Northeast remaining the least developed. The Northeastern state of Bahia ranked 22nd out of 27 states on the UN’s Index of Human Development (http://www.pnud.org.br/IDH/DH.aspx# and http://www.atlasbrasil.org.br/2013/pt/home/). The State capital, Salvador, ranks 14th out of 20 major metropolitan regions and is one site for this study abroad program. The second site, the rural town of Ubaíra, is ranked 4590 out of 5565 municipalities. Even with large social inequities and health care disparities, the Brazilian government and society have produced remarkable social policies, have shown a willingness to implement these policies and have the resources to significantly improve the lives of its most impoverished citizens. Critical basic infrastructure for health and development is water. Its consumption is essential; it is a mechanism for waste disposal, industry and agriculture are dependent on its supply. The problem of water quantity and quality are common all human societies (witness the drought in California and the burning Cuyahoga). Individuals from all walks of life will need to assess issues of water at some time, from doctors, engineers, urban planners, lawyers and politicians. In Brazil the issues of water are more exposed and easier to examine on different scales than in the U.S. The problem also resides within a social, health care, and political context that compares well and at the same time contrasts sharply with that of the USA. As a student in this course, you will gain first-hand knowledge of the social and public health challenges regarding water security in Brazil. Through field experiences in the capital city of Salvador and the rural town of Ubaíra, you will immerse yourself in interdisciplinary perspectives on the public health, scientific, political, and bioethical dimensions of water security in Brazil. This immersive experience will be facilitated by faculty from the CWRU Dept. of Bioethics and the Center for Global Health and Diseases, the Brazilian Ministry of Health, the Federal University of Bahia, the Bahiana School of Medicine and Public Health, and Brazilian graduate student participants. Offered as: INTH 315, INTH 415, BETH 315H, and BETH 415H. Counts for CAS Global & Cultural Diversity Requirement.

BETH 353. Hindu and Jain Bioethics. 3 Units.
This course will provide both an introduction to basic Hinduism and Jainism and an introduction to Hindu and Jain bioethics. We will ask: How would a Hindu or a Jain respond to issues concerning euthanasia, abortion, and other topics of controversy. Are these answers altered in the North American context or in the light of recent technological changes? Offered as RLGN 353, RLGN 453, BETH 353, and BETH 453. Counts for CAS Global & Cultural Diversity Requirement.
BETH 360. Science and Society. 3 Units.
This course examines the complex ethical and other value relationships that exist between science and society. Students will be encouraged to question the simplistic view that science proceeds independently of societal values and contentious ethical commitments. A range of other social factors, such as ethical belief systems, political forces, and large-scale financial interests all influence new scientific and technological developments. In order to illuminate each of these larger themes, this course focuses on three exciting areas of scientific inquiry: stem cell research; synthetic biology, and nanotechnology. Each of these contentious scientific fields provides an excellent view into the challenging ethical, cultural, social, political, and economic issues that will face students, both as scholars and as citizens. No prior technical knowledge is necessary for any of these scientific areas. All relevant scientific information will be provided during the course by the professor. Offered as BETH 360, BETH 460 and PHIL 360.

BETH 371. Advanced Bioethics. 3 Units.
This course offers upper-level instruction on many key bioethical issues introduced in BETH/PHIL 271. The class follows a discussion-intensive seminar format. Students begin with an in-depth analysis of ethical issues surrounding the conduct of clinical trials, both within the U.S. and through U.S.-sponsored research abroad. Next students examine the philosophical and practical challenges involved in medical decision making for adults and pediatric patients. This course concludes by addressing the broader ethical problem of what duties we owe to future generations in terms of our reproductive choices and the allocation of health-related public expenditures. Each of these general topic areas - clinical trials, medical decision making, and future generations - is of crucial importance for all students whether one plans to enter a career in biomedical research, the healthcare professions, or some other career path. Everyone is a potential patient or the family member of a potential patient. The topics covered in Advanced Bioethics will help prepare students to become responsible participants in an increasingly complex biomedical world. Offered as BETH 371 and PHIL 371. Prereq: BETH 271 or PHIL 271.

BETH 371C. Advanced Bioethics: Clinical Observation. 1 Unit.
This course is a one credit class intended to supplement BETH 371: Advanced Bioethics. In this course students will become familiar with the clinical, psychological, social, professional, and institutional context in which bioethical problems arise. Students are exposed to clinical cases as they arise, to hospital ethics committees and ethics consultation programs, to institutional review boards (IRB), and to hospital policies covering the "do not resuscitate" orders (DNR), advance directives, withdrawal of artificial feeding, organ procurement and transplantation, and medical futility. Requires minimum of 8 total hours of rotation experience per week during two semester 10-week rotations. Locations for this course include: MetroHealth Medical Center, University Hospitals of Cleveland, and the Hospice of the Western Reserve. Recommended preparation: BETH 401 or concurrent enrollment.

BETH 372. Bioethics in the Workplace. 2 Units.
This course focuses on the workplace as a microcosm of the larger social structures with which we interact. This course introduces students to the ways in which bioethical problems arise in the workplace and how these problems are addressed. The course will cover a broad range of issues such as: workplace discrimination and sexual harassment; workplace wellness programs; human subject research in the workplace; workplace ethics committees; and workplace policies. The course meets twice weekly and is taught in seminar format by Center faculty members who are experts on specific topics. Recommended preparation: BETH 401.

BETH 395. Research Ethics. 1 Unit.
This course provides an introduction to the ethical issues that arise in the conduct of biomedical research. The course will cover the ethical issues that arise in the conduct of research with human subjects, including issues of institutional review boards, informed consent, confidentiality, and the protection of vulnerable populations. The course will also cover the ethical issues that arise in the conduct of research with animals, including issues of animal welfare and the justification of animal research. The course meets twice weekly and is taught in seminar format by Center faculty members who are experts on specific topics. Recommended preparation: BETH 401.

BETH 398. Internship. 1 Unit.
This course provides an opportunity for students to gain practical experience in a bioethics-related setting. The course is designed for students who have completed the required coursework in bioethics and are seeking to apply their knowledge and skills in a real-world setting. The course meets twice weekly and is taught in seminar format by Center faculty members who are experts on specific topics. Recommended preparation: BETH 401.

BETH 400. Seminar in Bioethics. 3 Units.
This course completes the required seminar core and covers the basic bioethics topic areas: health care justice; defining 'health care needs'; reproduction and fertility ethics; research ethics; and ethics in genetics. This course meets twice weekly and is taught in seminar format by Center faculty members who are experts on specific topics. Recommended preparation: BETH 401.

BETH 401. Foundations in Bioethics I. 6 Units.
The first of the two required seminar courses, this course covers five basic topic areas in bioethics: death and dying; health professional-patient relationship; method and theory in bioethics; organ transplantation; and ethics and children. The course meets twice weekly and is taught in seminar format by Center faculty members who are experts on specific topics. Preentry.

BETH 402. Foundations in Bioethics II. 6 Units.
This course completes the required seminar core and covers the basic bioethics topic areas: health care justice; defining 'health care needs'; reproduction and fertility ethics; research ethics; and ethics in genetics. The course meets twice weekly and is taught in seminar format by Center faculty members who are experts on specific topics. Recommended preparation: BETH 401.

BETH 405. Clinical Ethics Rotation. 1.5 - 3 Units.
In this course students will become familiar with the clinical, psychological, social, professional, and institutional context in which ethical problems arise. This course exposes students to clinical cases, to hospital ethics committees and ethics consultation programs, to institutional review boards (IRB), and to hospital policies covering the "do not resuscitate" orders (DNR), advance directives, withdrawal of artificial feeding, organ procurement and transplantation, and medical futility. Requires minimum of 8 total hours of rotation experience per week during two semester 10-week rotations. Locations for this course include: MetroHealth Medical Center, University Hospitals of Cleveland, and the Hospice of the Western Reserve. Recommended preparation: BETH 401 or concurrent enrollment.

BETH 406. Society, Religion, and Bioethics. 3 Units.
Focus and Scope of Course: The course examines the interplay of politics, governmental structures, culture and religion and their impact on ethics questions that arise in the health arena. The course provides a broad overview of the basic tenets of several major faith traditions and examines how and why the interpretation of such tenets and their impact on bioethics issues varies across different societies. The specific domains in which we explore such issues, e.g., reproductive health, regenerative medicine, end-of-life issues, infectious disease, may be rotated each year. Objectives: Students will be able to *Describe how religious views and interests affect policymaking with respect to a variety of health-related issues *Enunciate strategies for the reconciliation of bioethics perspectives stemming from diverse religious interests in a pluralistic society *Compare and contrast the perspective of various world religions with respect to specific bioethics issues. Prereq: Open to Graduate Students and Seniors only.

BETH 407. Interprofessional Integrative Seminar. 0 Unit.
This is an integrative seminar for dual professional degree students in Bioethics, e.g. Bioethics and Law, Bioethics and Public Health, Bioethics and Medicine. It is required for all dual professional degree students in Bioethics who were admitted to Bioethics on or after January 1, 2013. Students are required to take the seminar for two semesters at any time during their Bioethics program. The course focuses on the study of selected texts with respect to ethical issues and interprofessional relationships. Prereq: Must be a dual professional degree student.

BETH 408. Ethics, Law and Health Research. 3 Units.
This course focuses on an examination of issues arising at the juncture of law, ethics, and health research, such as informed consent, the assessment of risks and benefits, conflict of interest, and scientific misconduct. Particular attention is placed on issues arising in the context of study design and community based research. To the extent possible, the class will utilize a case-focused approach.
BETH 409. Global Justice and Bioethics. 3 Units.
This course aims to introduce students to the problem of global distributive justice, with an emphasis on both theoretical accounts of justice, and the practical implications of those accounts for important topics in global bioethics. The first half of this course will be devoted to important contemporary works which bring out core philosophical ideas about justice and how we address concerns of justice globally. The second half of this course will focus on current global bioethics topics, such as inequality and poverty, global intellectual property rights, the allocation of healthcare resources, the setting of research priorities, exploitation & the distribution of the benefits of research, and medical tourism. In addition to familiarizing students with the contemporary literature regarding global justice and related topics in bioethics, this course also seeks to help students strengthen their skills in reading, analyzing, interpreting, and engaging with philosophy and bioethics texts. This course is a seminar and will therefore emphasize in-class discussion rather than lecture. Students are expected to prepare by reading all assigned readings before class.

BETH 410. Foundations of Medicine, Society and Culture. 3 Units.
Topics will include comparative medical systems and concepts of health, medical history, illness narratives and narrative ethics, social determinants of health and health inequalities, analysis of representations of illness and medicine in literature and the arts, and medical rhetoric. Students who complete the course should develop a command of the basic problems, approaches, and literatures in the social and cultural contexts of health sickness, and medicine. Students will be able to identify epistemology, theory, methodology and data from neighboring disciplines and understand affordances and costs in each.

BETH 411. Narrative Medicine: Methodology in patient-centered medical education. 3 Units.
Narrative Medicine, or medicine practiced with narrative skills (as defined by Rita Charon, MD, PhD), is a methodology in patient-centered medical education. Narrative medicine is informed by the theory and practice of reading, writing, telling, and receiving of stories as a clinically empowering practice for anyone engaged (or planning to engage) in the field of healthcare. This course will employ various methods of learning and experiencing narrative, including fundamental skills of close reading and reflective writing and other forms of self-representation. Narrative competence is an important skill that enables a person to "recognize, absorb, interpret, represent, and be moved by the stories of illness". Major themes throughout the course will include caregivers' and patients' empowerment, empathy, narrative ethics, testimony, reflexive writing, and illness and medical stories. The course will be conducted in a seminar-type format. Each session will have readings that relate to the theory of narrative (primarily from the Charon textbook but also from other sources in the Ethics and Humanities professional literature) and related health humanities. Many of the sessions will also include the application of reflective practice/close reading. Additional elements will be writing workshops and use of film and visual art as narrative. The class will meet once weekly for a 3 hour session. This class is open to graduate students in any humanities or healthcare field, and will be especially useful to those who intend to have a future career in which direct care of patients/clients is a part of their work.

BETH 412. Ethical Issues in Genetics/Genomics. 3 Units.
This course is designed to familiarize graduate students with the major controversies over the generation and use of new human genetic information. Topics will include the spread of predictive genetic testing, prenatal diagnosis, genetic discrimination, human genetic variation research, eugenics, genetic counseling, and the limits of human gene therapy. The course will be conducted as a seminar, involving discussions of readings, guest speakers, and student presentations.

BETH 414. International Health Research Ethics. 3 Units.
This course will introduce students in the health and social sciences to key ethical issues that arise in international health research. The course will include intensive reading and case-based discussion of current ethical and moral quandaries posed by research conducted in the international arena. Five full-day sessions are planned. Each day will be divided into a series of formal presentations and active, group-based discussions around topics that include: the historical context of international health research; current international ethics principles, standards, and declarations; key tools and concepts for unpacking ethical issues in international health research; issues in informed consent and conflict of interest; "reasonable availability" and the conduct of clinical trials; cutting-edge international genetics research; and, the responsibility of researchers to the international health community. Course evaluation is based on class participation, a written exercise, and a case analysis.

BETH 415. International Bioethics: Policy and Practice. 3 Units.
Taught by Case and international faculty, this course will include 7-10 days of intensive didactic and experiential learning in one of several "host" countries. Examples of sites include: Free University of Amsterdam and University of Utrecht in the Netherlands; University of Paris in France; and Ben Gurion University in Israel. It will afford a unique opportunity to gain perspective on important bioethics issues in different societies, i.e., euthanasia, public health policies, access to healthcare, and stem cell research. At the international site, students will spend 6 hours per day (5 days) in seminar (involving didactics, discussion, and guided-observation clinical experience). There will be two 3-hour preparatory sessions, required reading, and two 3-hour post trip sessions. Requirements: preparation, attendance, and class participation, a 12-15 page paper (undergraduate credit) and a 15-20 page paper (graduate credit). Graduate credit will also require students to prepare a presentation for a post-intensive session. Enrollment will be capped at 25. This course has an additional fee to cover costs of travel and lodging. Limited scholarships are available. Offered as BETH 315 and BETH 415.

BETH 415A. International Bioethics Policy and Practice: Women's Health in the Netherlands. 3 Units.
This 3-credit course allows students to familiarize themselves with social policies and practices related to women's health in the United States and the Netherlands. Issues covered in the course include birth control and family planning, abortion, prenatal testing, childbirth, health care disparities, cosmetic surgery, prostitution and trafficking in women. This course also addresses the US and Dutch national policies regarding the public provision of health care for women. The course places an emphasis on the ways in which social norms shape policies over time, which political actors are involved in shaping women's health policy, and the balance between women's health as a matter of the public good or individual responsibility. This course substantively explores gender-specific cultural values and practices in relation to women's health in the United States and the Netherlands and will help students develop the analytical skills necessary for evaluating social policy and ethical issues related to women's health. Offered as BETH 315A and BETH 415A. Counts for CAS Global & Cultural Diversity Requirement.
BETH 415B. International Bioethics Policy and Practice: Public Health in the Netherlands. 3 Units.
This one week 3-credit intensive course will be held in Amsterdam, The Netherlands. Taught by faculty from Case and Utrecht University, this course offers students a cross-cultural perspective on ethical dilemmas raised by the practice of public health in the United States and Northern Europe. Additionally, this course examines policies related to prostitution, drug use, sex education, infectious disease prevention, and access to health care and how they differ in the cultural and political settings of U.S. and the Netherlands. We will examine both the rationales and outcomes of Dutch and American policies, stimulating course participants to consider their own views on these often controversial issues. Prior to the trip, students will attend lectures at Case, which will acquaint them with the theoretical approaches to public health ethics and major issues raised in the practice of public health. In these pre-trip sessions, students will also analyze and report on a case study designed to stimulate critical thinking on comparative public health ethics. In Amsterdam, students will attend lectures that will be supplemented by site visits and discussion sessions aimed at exploring the ethics of public health policy and practice in the Netherlands. Following the intensive week in Amsterdam, students will meet with instructors at Case for two hours to discuss their experiences and compare policies and practices in the U.S. and the Netherlands. Offered as BETH 315B and BETH 415B. Counts for CAS Global & Cultural Diversity Requirement.

BETH 415C. International Bioethics Policy and Practice: Health Care Costa Rica. 3 Units.
This 3-credit course gives students the unique opportunity to observe patients and practitioners encounter in a radically different health care system. Costa Rica has one of the most comprehensive health care systems in the Western hemisphere, featuring the innovative use of mid-level health care workers organized in basic comprehensive health care teams. This has resulted in a longer life expectancy than the United States, despite a per capita GDP of only $10,000 per person. Students will gain first-hand experience of Costa Rican health care through field experiences at sites including a national hospital in the capital city, San Jose; a peripheral treatment clinic in a smaller town; and observation of the work of an integrated basic health care team in an indigenous reserve. Following each visit, students will discuss the practical and ethical dilemmas that practitioners face in the context of the Costa Rican health care system. Specific topics include: health inequalities within and between nations; the ethics of transplantation, medical research, and end-of-life care; and health care in rural environments with indigenous populations. Offered as BETH 315C and BETH 415C. Counts for CAS Global & Cultural Diversity Requirement.

BETH 415D. French Connections, A Cross-Cultural Comparison of Medical Ethics. 3 Units.
This 3-credit course is collaboration between Case Western Reserve University and the University of Paris. The course includes a ten-day trip to Paris, France over Spring Break. This course offers a cross-cultural comparison of the French and American medical systems. Students will have the unique opportunity to learn first-hand how the French medical education system is structured and how the social, cultural and political contexts in France shape medical and ethical issues. The trip includes guided field experiences in French clinical settings as well as opportunities to engage with French faculty members and physicians about contemporary issues in bioethics. Ethical issues that may be considered may include reproductive rights, decision-making involving severely impaired newborns, withholding/withdrawing life-sustaining treatment and issues in organ donation and transplant. The course also will also emphasize the role of French culture and history while in Paris with museum and site visits designed to complement seminar content and offer real-life illustrations of course content. Prior to the trip, students attend six hours of lectures, either at Case Western Reserve University or via a web-based tutorial. They are expected to become familiar with the representative articles assigned for the course, and be prepared to integrate those readings into pre-trip class participation and active participation while in France. Following the trip, students meet with the instructor for an additional four hours to discuss and synthesize their experiences. Offered as BETH 315D and BETH 415D. Counts for CAS Global & Cultural Diversity Requirement.

BETH 415E. International Bioethics: Policy and Practice--US and Spanish Perspectives, Salamanca Spain. 3 Units.
This 3-credit hour course will introduce advanced undergraduate and graduate students to theoretical and practical aspects of bioethics in a European context. Continental health professionals and bioethicists work in an environment that differs from the American context in at least three important dimensions: the political structure of their health care systems, the cultural influence of their religious histories, and the theoretical perspective of continental moral philosophy. The University of Salamanca in Spain, one of the oldest universities in Europe (known as the "Oxford of Spain"), will be used in this course as a focal point for examining the interplay of these three dimensions in shaping institutional and professional approaches to specific problems in bioethics, including end of life decisions, organ procurement and allocation, reproductive ethics, health care justice, and environmental bioethics ("eco-ethics"). This course will help advanced students who are already grounded in American bioethics develop the analytical skills necessary for evaluating European bioethical scholarship and policy-making, while helping less advanced students develop a familiarity with fundamental similarities and differences between bioethics in Spain and the U.S. The course will include a one week trip to Salamanca, Spain where students will be taught by instructors and faculty from the University of Salamanca. Teaching will include some guided field experiences and regular discussion sessions with the course faculty. Prior to the trip, students will attend 4 hours of class at Case to become familiar with elements of political theory and moral philosophy relevant to the in-country discussions. Following the trip, students will meet with instructors for an additional 2 hours. Offered as BETH 315E and BETH 415E. Counts for CAS Global & Cultural Diversity Requirement.
BETH 415F. Bioethics Themes as Expressed in Spanish and American Culture: Film, Television, and Literature. 3 Units.
This 3-credit intensive course will be held in San Sebastian, Spain. Taught by faculty from CWRU and University of the Basque Country, this course offers students a cross-cultural perspective on bioethics in the United States and Spain. This course uses the medium of film, complemented by readings in bioethics, film criticism, and medical research, to introduce students to a number of compelling bioethics problems facing physician-scientists today, including: when life begins, the nature and limits of informed consent, use of randomization without equipoise, medical imperialism (or the appearance thereof), the treatment of so-called "orphan" diseases, use of deception in research, and financial conflicts of interests caused by among other things, the involvement of the pharmaceutical industry in the drug invention process. Offered as BETH 315F and BETH 415F. Counts for CAS Global & Cultural Diversity Requirement.

BETH 415G. Death, Dying & Euthanasia: Netherlands & the USA. 3 Units.
Is it ever permissible for physicians to kill their patients? In the Netherlands, the answer is yes. In the United States, it is no. Are the Dutch sliding down a moral slippery slope? Are the Americans compromising the rights and dignity of dying patients? This 3-credit course is a unique opportunity to examine a range of Dutch and American end-of-life policies and practices with special focus on the unique ethical, cultural, religious, and legal contexts in which they developed. This course will compare how two liberal democracies, the United States and the Netherlands, have handled difficult end-of-life issues, including: The Dutch regulation of euthanasia; Regulation of physician-assisted suicide in the state of Oregon; Terminal sedation; End-of-life decisions in newborns; Withholding and withdrawing of artificially-provided fluids and nutrition; The legal basis for end-of-life decision making in the USA; Palliative care and hospice; Public trust in medicine and physicians. In the United States, teaching methods will include lectures, case discussion, and exposure to how some of the course's themes are reflected in popular culture such as movies. Offered as BETH 315G and BETH 415G. Counts for CAS Global & Cultural Diversity Requirement.

BETH 415H. Water Security and Social Justice in Brazil. 3 Units.
CWRU, through the Center for Global Health and Diseases, has had projects, student exchanges and courses with institutions in Brazil and especially with the state of Bahia for over 30 years. In that time, personal and professional relationships have been developed with branches of the Ministry of Health (Oswaldo Cruz Foundation, the Municipal and State Health Departments), the Federal University of Bahia, and the Bahiana School of Medicine and Public Health. Brazil is the second largest country in the Western Hemisphere and the 7th or 8th largest economy in the world. There are more people who speak Portuguese in South America than Spanish. Despite newly discovered oil, enormous natural and human resources, development in Brazil has been uneven with the Northeast remaining the least developed. The Northeastern state of Bahia ranked 22nd out of 27 states on the UN¿s Index of Human Development (http://www.pnud.org.br/IDH/DH.aspx# and http://www.atlasbrasil.org.br/2013/pt/home/). The State capital, Salvador, ranks 14th out of 20 major metropolitan regions and is one site for this study abroad program. The second site, the rural town of Ubaíra, is ranked 4590 out of 5565 municipalities. Even with large social inequities and health care disparities, the Brazilian government and society have produced remarkable social policies, have shown a willingness to implement these policies and have the resources to significantly improve the lives of its most impoverished citizens. Critical basic infrastructure for health and development is water. Its consumption is essential; it is a mechanism for waste disposal, industry and agriculture are dependent on its supply. The problem of water quantity and quality are common all human societies (witness the drought in California and the burning Cuyahoga). Individuals from all walks of life will need to assess issues of water at some time, from doctors, engineers, urban planners, lawyers and politicians. In Brazil the issues of water are more exposed and easier to examine on different scales than in the U.S. The problem also resides within a social, health care, and political context that compares well and at the same time contrasts sharply with that of the USA. As a student in this course, you will gain first-hand knowledge of the social and public health challenges regarding water security in Brazil. Through field experiences in the capital city of Salvador and the rural town of Ubaíra, you will immerse yourself in interdisciplinary perspectives on the public health, scientific, political, and bioethical dimensions of water security in Brazil. This immersive experience will be facilitated by faculty from the CWRU Dept. of Bioethics and the Center for Global Health and Diseases, the Brazilian Ministry of Health, the Federal University of Bahia, the Bahiana School of Medicine and Public Health, and Brazilian graduate student participants. Offered as: INTH 315, INTH 415, BETH 315H, and BETH 415H. Counts for CAS Global & Cultural Diversity Requirement.

BETH 417. Introduction to Public Health Ethics. 3 Units.
The course will introduce students to theoretical and practical aspects of ethics and public health. This course will help students develop the analytical skills necessary for evaluating ethical issues in public health policy and public health prevention, treatment, and research. Will include intensive reading and case-based discussions. Evaluation based on class participation, a written exercise and a case analysis. Open to graduate students with permission from instructors.
BETH 421. Research Ethics Practicum. 1.5 Unit.
The Research Ethics Practicum (80 hours, 1.5 CREDITS) is designed to complement the theoretical and conceptual training received in the course, Critical Issues in Research Ethics. By way of a series of campus-wide rotations, students learn about the practical, everyday side of research administration, compliance, and scientific review. Students will work with key staff in research ethics centers, and observe their day-to-day operations, as well as attend institutional review board (IRB) and Institutional Animal Care and Use Committee (IACUC) meetings. They will become familiar with human subjects, animal, and tissue research regulations and policies as these are applied in an institutional/academic research context. Students will also spend time in a clinical trials unit and tour animal care facilities. The practicum has the following overall objectives: (1) students will be able to identify, analyze, and understand research ethics issues as they develop in the context of actual institutional research governance (2) students will gain an understanding of methods of ethical research design and implementation.

BETH 422. Clinical Ethics: Theory & Practice. 3 Units.
This course will focus on both theoretical and practical issues in clinical ethics. Clinical ethics will be distinguished from other areas of bioethics by highlighting distinctive features of the clinical context which must be taken into account in clinical ethics policy and practice. Fundamental moral and political foundations of clinical ethics will be examined, as will the role of bioethical theory and method in the clinical context. Topical issues to be considered may include informed consent; decision capacity; end of life decision making; confidentiality and privacy; the role and function of ethics committees; ethics consultation; the role of the clinical ethicist; decision making in various pediatric settings (from neonatal through adolescent); the role of personal values in professional life (e.g., rights of conscience issues, self disclosure and boundary issues); dealing with the chronically non-adherent patient; ethical issues in organ donation and transplant; health professional-patient communication; medical mistakes; and other ethical issues that emerge in clinical settings.

BETH 430. Bioethics in Literature. 1 Unit.
This course complements the Foundation course in the MA bioethics program by introducing students to narrative literature (fiction, nonfiction and poetry) that addresses ethical issues in medicine. The material is frequently the work of physicians and patients who narrate their respective experiences. As such, narrative provides direct insights into the practice of modern medicine tested against both accepted and controversial moral norms and serves as a vehicle for discussion and analysis of ethical issues. These issues involve topics such as death and dying, reproduction, pediatrics, women as patients and clinicians, public health and medicine as a profession and its practice as a privilege. Students will sample the work, among others, of William Carlos Williams, Lewis Thomas, Toni Morrison, Margaret Atwood, John Donne, Dylan Thomas and Abraham Verghese.

BETH 440. Science and Society Through Literature. 3 Units.
This course will examine the interaction of scientific investigation and discovery with the society it occurred in. What is the effect of science on society and, as importantly, what is the effect of society on science? An introduction will consider the heliocentric controversy with focus on Galileo. Two broad areas, tuberculosis and the Frankenstein myth, will then be discussed covering the period 1800-present. With tuberculosis, fiction, art and music will be examined to understand the changing views of society towards the disease, how society’s perception of tuberculosis victims changed, and how this influenced their treatments and research. With Frankenstein, the original novel in its historical context will be examined. Using fiction and film, the transformation of the original story into myth with different connotations and implications will be discussed. Most classes will be extensive discussions coupled with student presentations of assigned materials. Offered as PHRM 340, BETH 440, PHRM 440, and HSTY 440.

BETH 453. Hindu and Jain Bioethics. 3 Units.
This course will provide both an introduction to basic Hinduism and Jainism and an introduction to Hindu and Jain bioethics. We will ask: How would a Hindu or a Jain respond to issues concerning euthanasia, abortion, and other topics of controversy. Are these answers altered in the North American context or in the light of recent technological changes? Offered as RLGN 353, RLGN 453, BETH 353, and BETH 453. Counts for CAS Global & Cultural Diversity Requirement.

BETH 460. Science and Society. 3 Units.
This course examines the complex ethical and other value relationships that exist between science and society. Students will be encouraged to question the simplistic view that science proceeds independently of societal values and contentious ethical commitments. A range of other social factors, such as ethical belief systems, political forces, and large-scale financial interests all influence new scientific and technological developments. In order to illuminate each of these larger themes, this course focuses on three exciting areas of scientific inquiry: stem cell research; synthetic biology; and nanotechnology. Each of these contentious scientific fields provides an excellent view into the challenging ethical, cultural, social, political, and economic issues that will face students, both as scholars and as citizens. No prior technical knowledge is necessary for any of these scientific areas. All relevant scientific information will be provided during the course by the professor. Offered as BETH 360, BETH 460 and PHIL 360.

BETH 466. Promoting Health Across Boundaries. 3 Units.
This course examines the concepts of health and boundary spanning and how the synergy of the two can produce new, effective approaches to promoting health. Students will explore and analyze examples of individuals and organizations boundary spanning for health to identify practice features affecting health, compare and contrast practices and approaches, and evaluate features and context that promote or inhibit boundary spanning and promoting health. Offered as MPHP 466, PQHS 466, SOCI 466, NURS 466 and BETH 466. Prereq: Graduate student status or instructor consent.
BETH 503. Research Ethics and Regulation. 3 Units.
This course is designed to introduce students to the ethical, policy, and legal issues raised by research involving human subjects. It is intended for law students, post-doctoral trainees in health-related disciplines and other students in relevant fields. Topics include (among others): regulation and monitoring of research; research in third-world nations; research with special populations; stem cell and genetic research; research to combat bioterrorism; scientific misconduct; conflicts of interest; commercialization and intellectual property; and the use of deception and placebos. Course will meet once per week for 2 hours throughout the semester. Grades will be given based on class participation and a series of group projects and individual short writing assignments. Offered as BETH 503, CRSP 603 and LAWS 5225.

BETH 504. Critical Readings in Bioethics. 3 Units.
This course will focus on both normative (traditional) and descriptive (empirical) approaches to bioethics. It will be co-directed by two faculty members, one with a specialization in normative bioethics and one with a specialization in descriptive bioethics.

BETH 505. Methods Normative Bioethics. 3 Units.
The purpose of this intensive graduate seminar is to master and to critique core philosophical concepts that are implicit in a wide array of bioethical issues. We will critically examine in a range of contemporary ethical theories beginning with modern conceptions of individual autonomy and concluding with theories of ethical justification. While no advanced knowledge of ethical theories is presupposed, students are expected to come to class prepared with the course readings and to engage in rigorous philosophical discussions with one another and the professor.

BETH 506. Methods in Normative Bioethics II. 3 Units.
The second of the two required Methods seminars is designed to give graduate students an intensive introduction to the modes of moral reasoning that have been adopted and adapted by contemporary Bioethics, and the major critical perspectives that have been brought to bear upon them.

BETH 508. Research Design in Bioethics II. 3 Units.
The second of two empirical research courses will introduce students to theoretical and methodological approaches in the design and implementation of empirical research on topics in biomedical ethics. Students will be provided with a comprehensive and robust exploration of empirical models for the development of bioethics research and the skills for critically assessing the optimal methods for designing studies relevant to ethical issues in biomedicine. Prereq: BETH 507.

BETH 511. Grant Writing. 3 Units.
This course will teach students the fundamentals of writing a grant proposal. We will concentrate on NIH-style applications, although the principals of grant writing can be applied to any venue. In the process of working through devising a research question and study design, students will be encouraged to use this as an opportunity to think about their dissertation topic. In addition to applying theoretical and research design knowledge gained through their other core course work, the course will also teach students about how to complete application forms and to create a budget. We will also familiarize students with the peer review process. Each student will produce a draft grant application. The students will form a mock peer review section and will critique the grants.

BETH 512. Clinical Ethics Rotation - Ph.D.. 1.5 Unit.
In this course students will become familiar with the clinical, psychological, social, professional, and institutional context in which ethical problems arise. This course exposes students to clinical cases, to hospital ethics committees and ethics consultation programs, to institutional review boards (IRB), and to hospital policies covering the "do not resuscitate" orders (DNR), advance directives, withdrawal of artificial feeding, organ procurement an transplantation, and medical futility. Requires minimum of 10 total hours of rotation experience per week during two semester 10-week rotations. Locations for this course include: MetroHealth Medical Center, University Hospitals of Cleveland, and the Hospice of the Western Reserve. Recommended preparation: BETH 520/BETH 521 or concurrent enrollment.

BETH 521. Foundations in Bioethics II - Ph.D.. 3 Units.
The second of the two required seminar courses, this course covers five basic topic areas in bioethics: death and dying; health professional-patient relationship; method and theory in bioethics; organ transplantation; and ethics and children. The course meets twice weekly and is taught in seminar format by Center faculty members who are experts on specific topics.

BETH 601. Special Topics in Bioethics. 1 - 3 Units.
Students will explore particular issues and themes in biomedical ethics in depth through independent study and research under the direction of a faculty member.

BETH 602. Bioethics Research. 6 Units.
Research leading toward the MD/MA degree is Bioethics.

BETH 604. Advanced Research Ethics Seminar. 0 Unit.
This course meets for two hours each month and is focused on the following topics and the development of the stated competencies:

- September: Introduction; How to critically analyze the literature; Facilitator critique of assigned manuscript; Developing re-entry projects
- October: Critical analysis of literature; Trainee #1 critique of assigned manuscript; Methodological and ethical issues in designing and reviewing research; Trainee presentation of concept papers for re-entry projects
- November: Critical review of research protocols and manuscripts; Issues in designing research; Trainee #2 critique of assigned manuscript; How to prepare and present professional presentations
- December: Critical analysis of literature; Oral presentation skills; Development of teaching skills; January: Trainee #1 critique of assigned manuscript; Principles of adult education
- February: Critical analysis of literature; Oral presentation skills; Development of teaching skills; February: Trainee #2 critique of assigned manuscript; Developing submissions for IRB review
- March: Principles of adult education; Critical analysis of literature; Oral presentation skills; Development of teaching skills; Readjustment.

This course is only open to trainees in the Fogarty-funded Training Program in International Research Ethics.
The Case Comprehensive Cancer Center (Case CCC) is one of only 41 National Cancer Institute-designated Comprehensive Cancer Centers in the country. The Case CCC integrates the cancer research activities of the largest medical collaborative in Ohio, Case Western Reserve University (CWRU), University Hospitals Case Medical Center and Cleveland Clinic - under a single leadership structure. Our researchers dedicate themselves to improving cancer outcomes through basic studies into signaling pathways giving rise to cancer and its genetic and epigenetic causes, pursuing novel therapeutic targets, and analyzing lifestyle interventions to prevent cancer and detect it earlier.

The Case CCC has over 360 collaborating scientists and physicians who have successfully competed for over $119 million in annual funding. These investigators are organized into eight interdisciplinary scientific programs and have access to 15 Scientific Core Facilities. A unified approach to research and education objectives. The division is the equivalent of an academic department, and its constituent units are characterized as Centers. The Dean of the School of Medicine serves as the Chair of the division; each Center is led by a director. The unique nature of each of the General Medical Sciences centers is described in the paragraphs below. (Centers are listed in alphabetical order by full title, and associated academic programs including certificate, MS and PhD programs described in top navigation tabs).

**Programs in Environmental Health Sciences** are on hiatus and are being reevaluated as part of the merger of the Department of Environmental Health Sciences and the Department of Epidemiology & Biostatistics into the new Department of Population & Quantitative Health Sciences.

**General Medical Sciences**

Contact: Main contact information is listed separately under each Center.

The Division of General Medical Sciences was established in 1986 to provide an organizational home for units pursuing interdisciplinary research and education objectives. The division is the equivalent of an academic department, and its constituent units are characterized as Centers. The Dean of the School of Medicine serves as the Chair of the division; each Center is led by a director. The unique nature of each of the General Medical Sciences centers is described in the paragraphs below. (Centers are listed in alphabetical order by full title, and associated academic programs including certificate, MS and PhD programs described in top navigation tabs).

**Case Comprehensive Cancer Center**

Phone: 216.844.8797
http://cancer.case.edu
Stanton L. Gerson, MD, Director, Case Comprehensive Cancer Center

The Case Comprehensive Cancer Center (Case CCC) is one of only 41 National Cancer Institute-designated Comprehensive Cancer Centers in the country. The Case CCC integrates the cancer research activities of the largest medical collaborative in Ohio, Case Western Reserve University (CWRU), University Hospitals Case Medical Center and Cleveland Clinic - under a single leadership structure. Our researchers dedicate themselves to improving cancer outcomes through basic studies into signaling pathways giving rise to cancer and its genetic and epigenetic causes, pursuing novel therapeutic targets, and analyzing lifestyle interventions to prevent cancer and detect it earlier.

The Case CCC has over 360 collaborating scientists and physicians who have successfully competed for over $119 million in annual funding. These investigators are organized into eight interdisciplinary scientific programs and have access to 15 Scientific Core Facilities. A unified approach to research and education objectives. The division is the equivalent of an academic department, and its constituent units are characterized as Centers. The Dean of the School of Medicine serves as the Chair of the division; each Center is led by a director. The unique nature of each of the General Medical Sciences centers is described in the paragraphs below. (Centers are listed in alphabetical order by full title, and associated academic programs including certificate, MS and PhD programs described in top navigation tabs).

**Center for Clinical Investigation**

Phone: 216.368.3286
http://cci.case.edu/cci/index.php/Main_Page
James Spilsbury, PhD, Academic Development Core Director

The Center for Clinical Investigation (CCI) was founded in 2007 and is part of Case Western Reserve University School of Medicine's Division of General Medical Sciences. The CCI serves as the academic home of Cleveland's Clinical & Translational Science Collaborative, a partnership of 4 local institutions (Case Western Reserve University, the Cleveland Clinic Foundation, the MetroHealth System, and University Hospitals) and member of a national consortium of approximately 66 institutions funded by the National Institutes of Health to increase the efficiency and speed of clinical and translational research across the country.

The CCI's mission is to enhance clinical and translational research efforts across the Cleveland area by: (1) spurring advances in knowledge of risk factors, outcomes and treatment effectiveness in the population; (2) facilitating the transfer of scientific advances to the community; and (3) developing a new generation of clinical researchers equipped with the skills needed to efficiently design, implement and interpret novel studies that address important public health questions. To accomplish its mission, the CCI provides computer systems and applications support for basic science and clinical research activities and works closely with basic science and clinical investigators in the CWRU Schools of Medicine, Nursing, and Dental Medicine, as well as the University Hospitals Case Medical Center, Cleveland Clinic, and MetroHealth System. The CCI has supported hundreds of clinical research and epidemiology projects, including local and national multicenter, longitudinal studies. The CCI has two cores that provide research support to all investigators: the Academic Development Core and Statistical Sciences Core.

The Academic Development Core manages the newly created PhD Program in Clinical Translational Science, the Master's Degree Program in Clinical Research (Clinical Research Scholars Program - see "Clinical Research MS" tab above), and the Graduate Certificate Program in Clinical Research. The Academic Development Core also delivers seminars and short courses in clinical research and works to coordinate educational activities in interdisciplinary clinical research across the CTSC's institutional members. The programs target investigators and other key members of the research team, including data managers and study coordinators. Training efforts in research design, research database management, statistical sciences, statistical software, and scientific communication are emphasized.
Center for Global Health and Diseases

Phone: 216.368.6321
http://www.case.edu/orgs/cghd/index.html
James W. Kazura, MD, Director

The Center for Global Health and Diseases links the numerous international health resources of the University, its affiliated institutions, and the northern Ohio community in transdisciplinary programs of research and education related to global health. The scope of the Center’s activities also includes education and service as these are related to molecular, clinical and population studies of human health and disease. The Center is currently a national leader in National Institutes of Health-supported studies of the major infectious diseases of developing countries. Cutting-edge approaches are implemented in order to examine the molecular, genetic and immunologic basis of susceptibility to infectious diseases of public health significance - malaria, river blindness, lymphatic filariasis, schistosomiasis, HIV and other viral diseases such as Rift Valley fever. Clinical research in endemic countries is concerned with testing and implementing cost-effective public health interventions that are aimed at the control of malaria and Neglected Tropical Diseases (worm infections of children, elimination of lymphatic filariasis). The Center has ongoing research and educational collaborations with academic and governmental institutions in Papua New Guinea, Brazil, Kenya, Uganda, and several other countries in Sub-Saharan Africa.

Educational programs sponsored by the Center include electives in international health, population biology, and genetics of infectious diseases (available to undergraduate, graduate and professional school students), a weekly World Health Interest Group (WHIG) seminar series, overseas rotations for graduate and professional school students, and training programs at the university and abroad for scholars from developing countries (with support from the Fogarty International Center at NIH).

A certificate in Global Health is available (see Certificates).

Center for Medical Education

Phone: 216.368.1948
Patricia A. Thomas, MD, FACP, Director
Klara Papp, PhD, Director, CAML

The Center for Medical Education, established in 2010, provides an organizational home for teaching and learning programs in the School of Medicine and a supportive environment for those who want to develop special skills in medical education.

The Center also sponsors faculty appointments, both full- and part-time, for faculty whose roles are predominantly focused on teaching medical students and physician assistant students. These include community clinicians who welcome medical students into their clinics and practices.

The Center for the Advancement of Medical Learning ("CAML") operates its programs under the auspices of the CMEd. CAML supports and promotes the development of teaching and lifelong-learning skills among students, faculty, staff, residents, and alumni. CAML pursues research into educational innovations to advance our knowledge of medical learning and teaching. The Center offers workshops to faculty locally, regionally, and nationally to enhance faculty teaching, research and evaluation skills.

Center for Proteomics and Bioinformatics

Phone: 216.368.0291
http://proteomics.case.edu
Biomedical Research Building, Ninth Floor

Mark R. Chance, PhD, Director

The Case Center for Proteomics and Bioinformatics was created, in part, to strengthen Cleveland’s presence in modern proteomics and bioinformatics research to make the region a leader in the field. The vision for the Center has been shaped over the past several years by the leadership of the Center’s Director, Mark Chance, Ph.D., with over $120 million in grants awarded to the Center and its collaborators since its inception in February 2006. One of the primary goals of the CPB is to develop an infrastructure of sophisticated equipment that facilitates and maximizes shared equipment usage, as well as to offer a wide array of proteomics and bioinformatics services including mass spectrometry, protein expression/interactions, systems biology, and biostatistical analyses.

The CPB has expanded its vision to include education of graduate students in systems biology and bioinformatics. The Center for Proteomics and Bioinformatics developed a graduate program in Systems Biology and Bioinformatics in collaboration with Schools and Departments across the campus. For more information regarding the SYBB graduate program please see “Systems/Bioinformatics” tab above. You may also visit http://bioinformatics.case.edu/.

Proteomics entails the in depth structural analysis of individual proteins in human and animal cells. In studying proteins and their changes, bioinformatics enables researchers to take an integrated -omics approach for discovering networks involved in human disease. The School of Medicine has established the Center for Proteomics and Bioinformatics to perform research to better understand the genetic and environmental bases of disease as well as provide new technologies to diagnose diseases such as cancer, heart disease, and diabetes.

New technologies in mass spectrometry are also allowing protein expression, localization, post-translational modifications, and interactions to be studied in increasing detail and on a genome wide scale. The Center is also developing and applying state-of-the-art structural proteomics technologies to understand the function and interactions of macromolecular complexes.

The CPB has three divisions: Proteomics and Genomics, Bioinformatics, and Macromolecular Structure.

Proteomics and Genomics Division

The mission of the Division of Proteomics and Genomics is to support research in protein and gene expression analysis, protein and gene modifications, and protein interactions in a wide variety of biological contexts. The division also develops new tools in Proteomics and Genomics research. Multiple Proteomics Cores support these activities.

Bioinformatics Division

The mission of the Division of Bioinformatics is to support interdisciplinary research and training in many areas of bioinformatics including analysis of DNA and protein sequences, protein interaction networks from whole genome expression data, analysis of signaling pathways from phospho-proteomics data, linkage and association studies for simple and complex traits, and gene and protein expression profiles. This includes a Bioinformatics Core that provides research support for these activities.

Macromolecular Structure Division

The mission of the Division of Macromolecular Structure is to support interdisciplinary research in new methods of structure determination, the combination of computational and experimental structural biology approaches, and developing and maintaining infrastructure for macromolecular structure determination. The Division will work closely and coordinate their activities with faculty and Departments in the University who use structural information to understand function as...
non-coding RNAs. RNA interference and regulation of gene expression by microRNAs and mechanisms of translation regulation, RNA degradation, RNA trafficking, include splicing and its regulation, RNA editing, tRNA maturation, to the roles of RNA processing in disease. Specific research interests on several problems ranging from extremely basic questions such as every aspect of RNA research. Current research in the Center focuses the mechanism of RNA catalysis and how proteins interact with RNA on the roles of RNA processing in disease. Specific research interests include splicing and its regulation, RNA editing, tRNA maturation, mechanisms of translation regulation, RNA degradation, RNA trafficking, RNA interference and regulation of gene expression by microRNAs and non-coding RNAs.

Collectively, the RNA Center provides a valuable resource for collaborative efforts within the University and its affiliated institutions: the Cleveland Clinic Foundation, MetroHealth Medical Center, the Cleveland VA Medical Center, and University Hospitals Cleveland Medical Center. In addition, the official journal of the RNA Society “RNA” was founded and continues to be housed in the RNA Center. The members of the RNA Center have an excellent funding record and the research performed is regularly published in highly visible journals such as Science, Nature, Molecular Cell, NSMB, Molecular Cell, etc.

Center for Psychoanalytic Child Development

Phone: 216.991.4472
Kimberly Bell (kmb207@case.edu), PhD; John A. Hadden Jr. Assistant Professor of Psychoanalytic Child Development

The Center for Psychoanalytic Child Development was established in 2001 as a memorial to John A. Hadden Jr., past President of the Board of Trustees of the Cleveland Center for Research in Child Development and of the Hanna Perkins School. The mission of the center is to advance the science of psychoanalytic child development at the School of Medicine. The Center offers medical students and residents who are interested in working with children the opportunity for observational learning in the Hanna Perkins school. In addition, didactic courses, case conferences and supervision are available to deepen students' understanding of the relationship between physical and psychological development in the first 5 years of life.

The Center for RNA Science and Therapeutics

Phone: 216.368.0299
http://www.case.edu/med/rnacenter/home.htm
Jeffery M. Coller, PhD, Director

The Center for RNA Science and Therapeutics is a free standing academic unit in the basic sciences within the School of Medicine at Case Western Reserve University. The RNA Center was established in the mid-nineties as a core entity in recognition of the strong cadre of research laboratories devoted to studying post-transcriptional mechanisms of gene expression focusing on various aspects of RNA Biology. The current mission of the RNA Center is to parlay the strengths of RNA Center scientists towards the development of unique therapeutic initiatives. The RNA Center is combining the usage of nanoparticle technology with RNA science to develop new classes of drugs, leading towards the amelioration of a variety of diseases. Current efforts are focused on metabolic disorders, cancer immunotherapies, immunity, and protein replacement. In addition, we are developing new technologies that promise to improve diagnostics, allowing for earlier detection of a variety of human diseases, especially cancer.

The RNA Center contains one of the largest concentrations of RNA scientists in the nation. The faculty of the RNA Center cover nearly every aspect of RNA research. Current research in the Center focuses on several problems ranging from extremely basic questions such as the mechanism of RNA catalysis and how proteins interact with RNA to the roles of RNA processing in disease. Specific research interests include splicing and its regulation, RNA editing, tRNA maturation, mechanisms of translation regulation, RNA degradation, RNA trafficking, RNA interference and regulation of gene expression by microRNAs and non-coding RNAs.

Recognizing that the successful futures of Case Western Reserve University, the City of Cleveland, and Cuyahoga County are integrally related, the Center for Science, Health and Society (CSHS) was created in 2002 to focus the efforts of the University and the community in a significant new collaboration to impact the areas of health and healthcare delivery systems through community outreach, education, and health policy. The Center, based in the School of Medicine, with university wide associations is engaging the many strengths of the University and the community to improve the health of the community. The Center has engaged the community at the level of the individual and the neighborhood, in public and private schools, at civic and faith-based organizations, and at the level of governmental agencies and community leadership to identify community problems, perceptions, assets and resources; advise the community of faculty skills, assets and expertise; and, catalyze that community service based scholarship that benefits community interests and promotes mutual enhancement. The Center coordinates the Scientific Enrichment Opportunity outreach program that brings Cleveland high school students on to the medical school campus in the summer to work along with our distinguished faculty in their research labs, to introduce and stimulate the students and help prepare them to enter careers in the health career professions and biomedical workforce. The Center also coordinates the Mini Medical School Program presented every Spring and Fall to educate the community in the latest developments in healthcare, particularly those developed at CWRU. The overall goal of these programs is to educate and empower the community to become better consumers of healthcare and more informed and stronger advocates for healthcare policy and legislation in their own interests.

Center for the Study of Kidney Biology and Disease

Phone: 216.444.8415
John R. Sedor, MD, Director
Thomas H. Hostetter, MD, Co-director
Jeffrey Garvin, MD, PhD, Co-director
Jeffrey Schelling, MD, Co-director
Nathan A. Berger, MD, Director

Chronic Kidney Disease (CKD) is a growing public health problem in the United States. More than seventeen percent of US adults—more than 30 million Americans—have CKD. CKD generally progresses over time, and can cause cardiovascular disease, anemia, bone disease, fluid overload, and eventually end-stage kidney disease (ESKD). Patients with ESKD need renal replacement therapy, either from dialysis or a kidney transplant, to live. The risk of death for patients receiving dialysis is nearly eight times higher than the non-ESRD population, leading to a 20%
annual probability of death. Kidney disease disproportionately affects minorities and vulnerable populations. Kidney disease treatment is expensive and uniquely tied to federal expenditures through the Medicare entitlement program. The cost of care for ~ 550,000 ESKD patients is nearly $34 billion annually, exceeding the total NIH budget. Treating all health conditions of CKD and ESRD patients consumes nearly 25% of the Medicare’s budget.

The Center’s mission is to accelerate discovery and its translation for treatment and cure of kidney diseases in an interdisciplinary environment within the rich, research environment of the CWRU School of Medicine. The faculty is an accomplished and highly interactive group of investigators, based in the adult or pediatric Divisions of Nephrology in CWRU-affiliated hospitals as well as other clinical and basic science departments. Research interests of the faculty include digital pathology image analysis, glomerular diseases, diabetic and other chronic kidney diseases, epithelial cell biology and ion transport, tubular physiology, genetic epidemiology, health services research, renal transplantation, health disparities research and clinical trials. Center faculty are members of the NIDDK-funded Kidney Precision Medicine Project. Research projects use cellular, molecular biological, computational, genetic, genomic and epidemiological methods to study in vitro and animal models and/or patients. Many projects by Center investigators use health data, culled from electronic health records, and biological samples from patients with kidney diseases in order to generate novel hypotheses, which can then tested with animal models and cell lines. Training opportunities are available for undergraduate, pre- and post-doctoral students.

**National Center for Regenerative Medicine**

Phone: 216.368.3614  
http://www.ncrm.us/  
Stanton L. Gerson, MD, Director  
Jeremy Rich, MD, PhD, Co-Director

The Center for Regenerative Medicine is a multi-institutional center composed of investigators from Case Western Reserve University, University Hospitals Case Medical Center, the Cleveland Clinic, Athersys, Inc., and The Ohio State University. Building on over 30 years of experience in adult stem cell research in northeast Ohio, the Center was created in 2003 with a $19.4 million award from the State of Ohio as a Wright Center of Innovation. An additional $8M award in 2006 from the State of Ohio’s Biomedical Research and Commercialization Program (BRCP) was successfully completed and enabled 3 new clinical trials to enroll patients. In 2009, $5M was awarded by the Ohio Third Frontier (OTF) Research Commercialization Program (RCP) which further validated the Center’s ability to achieve its mission to utilize human stem cell and tissue engineering technologies to treat human disease. In 2010, $1M was awarded to the NCRM by the OTF Biomedical Program (OTFBP) to advance the clinical treatment of spinal cord injury, and a $2.1M OTF Wright Program Project (WPP) award was made to create a consortium of quantitative analysis imaging systems for stem cells.

**Clinical Research Scholars Program (CRSP)** ([http://casemed.case.edu/CRSP](http://casemed.case.edu/CRSP))

The Clinical Research program is designed for individuals with an existing degree in medicine, dentistry, nursing, or an allied science such as pharmacy or biomedical engineering. Moreover, a track has also been established for medical students interested in obtaining dual MD/MS degree. The program seeks individuals committed to a career in clinical investigation in an academic or related environment. The program consists of a total of 36 credits: 27 credit hours of coursework, 9 credit hours of mentored research and a formal oral thesis defense. The curriculum offers both focus and flexibility. Focus is provided through a core curriculum (13 credit hours) highlighting clinical research methods, the ethical conduct of research, and a seminar series that introduces the skills necessary for scholarly success. Students typically have special interests in a particular area of clinical research, both clinically and methodologically. This program facilitates pursuit of different methodological interests guided by seasoned CWRU research faculty and addressed partly with choice of appropriate electives (14 credit hours).

Requirements for the dual MD/MS degree differ to reflect integration of methodological interests guided by seasoned CWRU research faculty and methodologically. This program facilitates pursuit of different methodological interests guided by seasoned CWRU research faculty.

**CRSP Curriculum**

36 credit hours are required for completion of this Master of Science in Clinical Research degree.

**Core Courses and Thesis Requirement**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRSP 401</td>
<td>Introduction to Clinical Research Summer Series</td>
<td>3</td>
</tr>
<tr>
<td>CRSP 402</td>
<td>Study Design and Epidemiologic Methods</td>
<td>3</td>
</tr>
<tr>
<td>CRSP 412</td>
<td>Communication in Clinical Research - Grant Writing</td>
<td>1</td>
</tr>
<tr>
<td>NURS 630</td>
<td>Advanced Statistics: Linear Models</td>
<td>3</td>
</tr>
<tr>
<td>CRSP 413</td>
<td>Communication in Clinical Research - Oral Presentation, Posters, and the Mass Media</td>
<td>1</td>
</tr>
<tr>
<td>CRSP 603</td>
<td>Research Ethics and Regulation</td>
<td>1 - 2</td>
</tr>
<tr>
<td>CRSP 651</td>
<td>Clinical Research Scholars Thesis</td>
<td>9</td>
</tr>
</tbody>
</table>

**Total Units 21-22**

**Recommended Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRSP 406</td>
<td>Introduction to R Programming</td>
<td>2</td>
</tr>
<tr>
<td>CRSP 407</td>
<td>Logistic Regression and Survival Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CRSP 500</td>
<td>Design and Analysis of Observational Studies</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Units 8**

Each scholar is encouraged to develop his/her own area of concentration based on personal interests and needs. Typical areas of concentration include: Clinical Research Trials, Health Services Research and Outcomes, and Multidisciplinary/Translational Clinical Research. Please consult with CRSP faculty and your Research Mentor on which electives will best suit your needs.

**The choices of electives include but are not limited to:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRSP 410</td>
<td>Independent Study in Clinical Research</td>
<td>1 - 3</td>
</tr>
<tr>
<td>CRSP 501</td>
<td>Team Science - Working in Interdisciplinary Research Teams</td>
<td>1</td>
</tr>
<tr>
<td>CRSP 502</td>
<td>Leadership Skills for Clinical Research Teams</td>
<td>2</td>
</tr>
<tr>
<td>CRSP 503</td>
<td>Innovation and Entrepreneurship</td>
<td>1</td>
</tr>
<tr>
<td>CRSP 504</td>
<td>Managing Research Records - A System’s Approach</td>
<td>2 - 3</td>
</tr>
</tbody>
</table>
General Medical Sciences

CRSP 505 Investigating Social Determinants of Health 2-3
CRSP 510 Health Disparities 3
PQHS 411 Introduction to Health Behavior 3
PQHS 450 Clinical Trials and Intervention Studies 3
PQHS 467 Comparative and Cost Effectiveness Research 1

MS Clinical Research, Plan of Study

Prep Year

CRSP Program starts in the Summer Term of First Year
Year Total:

First Year

Elective 2-3
Study Design and Epidemiologic Methods (CRSP 402) 3
Communication in Clinical Research Grant Writing (CRSP 412) 1
Advanced Statistics: Linear Models (NURS 630) 3
Communication in Clinical Research Oral Presentation, Posters, and the Mass Media (CRSP 413) 1
Design and Analysis of Observational Studies (CRSP 500) 3
Elective 3
Introduction to Clinical Research Summer Series (CRSP 401) 3
Introduction to R Programming (CRSP 406) 2
Year Total: 9-10 7 5

Second Year

Fall Units Spring Summer
Research Ethics and Regulation (CRSP 603) 1 - 2
Clinical Research Scholars Thesis (CRSP 651) 3
Elective 3
Clinical Research Scholars Thesis (CRSP 651) 3
Clinical Research Scholars Thesis (CRSP 651) 3
Year Total: 7-8 3 3

Total Units in Sequence: 34-36

MD/MS Biomedical Investigation-Clinical Research Track

For information about Program Admission and MD requirements, please see MD Dual Degrees section (p. 724). The Clinical Research track includes formal instruction in methods common to all fields of clinical investigation along with mentored research. In addition to medical school credits, students must complete the track-specific courses and electives listed below.

All students in this track must complete the CRSP Core Curriculum or equivalents:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBIS 434</td>
<td>Integrated Biological Sciences in Medicine (or IBIS 401 and 402)</td>
<td>6</td>
</tr>
<tr>
<td>CMED 401</td>
<td>Intro to Clinical Research and Scientific Writing</td>
<td>3</td>
</tr>
<tr>
<td>or CRSP 401</td>
<td>Introduction to Clinical Research Summer Series</td>
<td></td>
</tr>
<tr>
<td>CMED 402</td>
<td>Statistical Science for Medical Research</td>
<td>3</td>
</tr>
<tr>
<td>CMED 403</td>
<td>Introduction to Clinical Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>or CRSP 402</td>
<td>Study Design and Epidemiologic Methods</td>
<td></td>
</tr>
<tr>
<td>CMED 404</td>
<td>Clinical Research Seminars (*)</td>
<td>1</td>
</tr>
<tr>
<td>or CRSP 412</td>
<td>Communication in Clinical Research - Grant Writing</td>
<td></td>
</tr>
<tr>
<td>CMED 405</td>
<td>Clinical Research Seminars (*)</td>
<td>1</td>
</tr>
<tr>
<td>or CRSP 413</td>
<td>Communication in Clinical Research - Oral Presentation, Posters, and the Mass Media</td>
<td></td>
</tr>
<tr>
<td>CMED 450</td>
<td>Clinical Trials</td>
<td>3</td>
</tr>
<tr>
<td>CMED 458</td>
<td>Statistical Modeling with Applications in Clinical Research</td>
<td>3</td>
</tr>
<tr>
<td>CMED 500</td>
<td>Scientific Integrity in Biomedical Research</td>
<td>0-1</td>
</tr>
<tr>
<td>or IBMS 500</td>
<td>On Being a Professional Scientist: The Responsible Conduct of Research</td>
<td></td>
</tr>
<tr>
<td>CMED 601</td>
<td>Clinical Research Project</td>
<td>18</td>
</tr>
<tr>
<td>IBIS 600</td>
<td>Exam in Biomedical Investigation</td>
<td>0</td>
</tr>
</tbody>
</table>

Program Advisors: Dr. Dennis Stacey (College students) and Dr. William Merrick (University students).

Registration permits for all CMED courses can be obtained from Dr. Ticknor’s office.

Certificate in Global Health

Ronald Blanton, MD, Director
216.368.4814

Daniel Tisch, PhD, Co-Director
216.368.0875

The Certificate is the centerpiece of the Framework for Global Health Curricula comprised of faculty from across the Case Western Reserve University campus, whose objective is to promote education in global health issues. Nearly every department at CWRU offers multiple educational activities in global health. Rather than attempt to own all of these activities, the group at CWRU (representing Applied Social Sciences, Anthropology, Bioethics, Biology, Engineering, Mathematics, Medicine, Nursing, Population and Quantitative Health Sciences) elected
to develop a structure within which each department could develop independently while taking advantage of what the others had to offer. The organizing structure for this became the certificate program rather than a separate degree. This approach recognizes that student’s need to graduate within a recognized discipline as well as recognition of a student’s focus, time and effort in training.

Each student in the Certificate program will be grounded in global health by a core course (INTH 301 Fundamentals of Global Health/INTH 401 Fundamentals of Global Health) that will allow them to understand concepts and vocabulary across disciplines and that will facilitate meaningful communication with others based in a different discipline. In addition to the Certificate, the Framework for Global Health Curricula had identified and is annotating all global health related courses at CWRU. It has supported the recent revival of Medical Spanish and new courses and electives in Global Health.

Requirements for Certificate in Global Health:

**Anthropology**

**Undergraduate:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTH 301</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 215</td>
<td>Health, Culture, and Disease: An Introduction to Medical Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 359</td>
<td>Introduction to International Health</td>
<td>3</td>
</tr>
</tbody>
</table>

And one elective selected from list of approved electives in the Anthropology Department

**Graduate:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTH 401</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 459</td>
<td>Introduction to International Health</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 511</td>
<td>Seminar in Anthropology and Global Health: Topics</td>
<td>3</td>
</tr>
</tbody>
</table>

And one elective selected from list of approved electives in the Anthropology Department

Contact: Janet McGrath (janet.mcgrath@case.edu), 216.368.2287

**Bioethics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTH 401</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>BETH 414</td>
<td>International Health Research Ethics</td>
<td>3</td>
</tr>
</tbody>
</table>

And complete one elective selected from list of approved electives in the Bioethics Department

Contact: Insoo Hyun (insoo.hyun@case.edu), 216.368-8658

**Population and Quantitative Health Sciences**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTH 401</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 484</td>
<td>Global Health Epidemiology</td>
<td>1-3</td>
</tr>
<tr>
<td>PQHS 494</td>
<td>Infectious Disease Epidemiology</td>
<td>3</td>
</tr>
</tbody>
</table>

And complete an epidemiology research project with global perspective (may be substituted with other course work).

Contact: Christopher Cullis (christopher.cullis@case.edu), 216.368.5362

**Math/Applied Math specialization:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTH 301</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>or INTH 401</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 431</td>
<td>Statistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>or PQHS 490</td>
<td>Epidemiology: Introduction to Theory and Methods</td>
<td>3</td>
</tr>
<tr>
<td>MATH 449</td>
<td>Dynamical Models for Biology and Medicine</td>
<td>3</td>
</tr>
<tr>
<td>or EECS 397/600</td>
<td>Special Topics</td>
<td></td>
</tr>
</tbody>
</table>

Complete a health related modeling project with global perspective (may be substituted with other course work).

Contact: Daniel Tisch (daniel.tisch@case.edu), 216.368.0875

**Medicine**

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTH 401</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
</tbody>
</table>

Complete global health related project (may be student’s thesis or may be substituted with other course work)

Contact: Ronald Blanton (ronald.blanton@case.edu), 216.368.4814

**Nursing**

**Undergraduate:**

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<td>INTH 301</td>
<td>Fundamentals of Global Health</td>
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<tr>
<td>NURS 372</td>
<td>Health in the Global Community</td>
<td>3</td>
</tr>
<tr>
<td>NURS 394</td>
<td>Global Health Seminar</td>
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Complete a global health related project (may be substituted with other course work)

**Graduate:**

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<td>INTH 401</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>NURS 394</td>
<td>Global Health Seminar</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 484</td>
<td>Global Health Epidemiology</td>
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<tr>
<td>or PQHS 494</td>
<td>Infectious Disease Epidemiology</td>
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</table>

Complete a global health related project (may be substituted with course work)

Contact: Elizabeth Madigan (elizabeth.madigan@case.edu), 216.368.8532

**Biology**

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<td>INTH 401</td>
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</tr>
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</table>

Complete a global health related project (may be substituted with other course work)

Contact: David Gurarie (david.gurarie@case.edu), 216.368.2857

**Engineering**

<table>
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</thead>
<tbody>
<tr>
<td>INTH 301</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
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</table>
the Scholar's presentations at a national conference, publications in peer reviewed journals and application for independent funding.

Formal Didactic Curriculum Coursework *:

IBMS 500 On Being a Professional Scientist: The Responsible Conduct of Research or CRSP 603 Research Ethics and Regulation
CNCR 501 Translational Cancer Research A (All four modules required, one each semester of the program (501-1, 501-2, 501-3, 501-4))

*Additionally, choose one course from following core courses for credit towards certificate:

CRSP 401 Introduction to Clinical Research Summer Series
CRSP 402 Study Design and Epidemiologic Methods
BIOC 460 Introduction to Microarrays
CRSP 406 Introduction to R Programming
CRSP 413 Communication in Clinical Research - Oral Presentation, Posters, and the Mass Media
CRSP 412 Communication in Clinical Research - Grant Writing
CRSP 500 Design and Analysis of Observational Studies
CRSP 501 Team Science - Working in Interdisciplinary Research Teams

Graduate Certificate in Clinical Research
James Spilsbury (james.spilsbury@case.edu), PhD, Director
Angela Bowling (angela.bowling@case.edu), Education Administrator Center for Clinical Investigation
http://case.edu/medicine/crsp/programs/certificate-program/216.368.2601

The Clinical Research Certificate program is a four course, 11 credit hour program. Students who successfully complete the required coursework will receive a Certificate in Clinical Research. Coursework includes: Introduction to Clinical and Translational Research; Study Design and Epidemiologic Methods; Advanced Statistics: Linear Models; and a course on Research Ethics and Regulation.

Admissions will be administered by the Clinical Research Scholars program in the Populations and Quantitative Health Science Department. Individuals who want to participate in the program will complete an online application form that includes a brief personal statement describing the reason(s) for seeking clinical research training and
a recent CV or resume. Per CWRU School of Graduate Studies requirements, individuals who are not already graduate-degree-seeking students at CWRU must submit to the School of Graduate Studies a completed non-degree application form. Individuals who are not faculty, staff, or employees of CWRU must also submit a transcript or copy of their diploma, documenting completion of a baccalaureate degree. Once accepted into the Certificate program, participants will register for the courses through the Student Information System. The program will have rolling admissions, and students will be able to start taking courses in the summer or fall semester. The coursework for the Certificate will be listed on the official CWRU transcript. However, the Certificate in Clinical Research will be issued by the Clinical Research Scholars Program, not the University, and will not appear on the official CWRU transcript.

Performance Standards: A grade of B or higher in each graded course will be required for successful completion of the Certificate program. Enrollees will be responsible for keeping track of the courses they take.

Required Courses:

<table>
<thead>
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<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>CRSP 401</td>
<td>Introduction to Clinical Research Summer Series</td>
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<tr>
<td>CRSP 402</td>
<td>Study Design and Epidemiologic Methods</td>
<td>3</td>
</tr>
<tr>
<td>NURS 630</td>
<td>Advanced Statistics: Linear Models</td>
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<tr>
<td>or CRSP 431</td>
<td>Statistical Methods I</td>
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</tr>
<tr>
<td>CRSP 603</td>
<td>Research Ethics and Regulation</td>
<td>2</td>
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</tbody>
</table>

Exit Standards: Students who complete all required coursework will submit a checklist to the Clinical Research Scholars Program (http://case.edu/medicine/crsp/programs/certificate-program) notifying the Education Administrator/Manager (axb710@case.edu) that their coursework has been completed. This administrator will verify with the registrar's office that all requirements have been met and will then issue a certificate to the enrollee, documenting completion of the program.

** Systems Biology and Bioinformatics MS and PhD Programs **

BRB 9th Floor, School of Medicine
http://bioinformatics.case.edu/
Phone: 216.368.0291
Mark Chance, PhD, Co-Director
David T. Lodowski, PhD, Co-Director

Data science is the convergence of data engineering, math, statistics, advanced computing, the scientific method and subject-matter expertise. It involves the collection, management and transformation of "big data" into actionable information that can answer some of the world's most pressing problems. Yet there is a distinct need for data science experts who can efficiently interpret data into information that is useful for strategic decision-making. It is the goal of the Systems Biology and Bioinformatics program to produce the scientists that are needed to equip them for their particular thesis research discipline. Each trainee will be guided in their customized course of study by a mentoring committee to ensure the completion of training in the program competencies as well as maintenance of a focus on molecular systems theory.

The Systems Biology and Bioinformatics PhD program at CWRU offers trainees the opportunity to combine both experimental and computational or mathematical disciplines to understand complex biological systems. The SYBB program will train scientists who are able to generate and analyze experimental data for biomedical research and to develop physical or computational models of the molecular components that drive the behavior of a biological system. The goal of the program is to produce scientists who are familiar with multiple disciplines and equipped to conduct interdisciplinary research.

The Case Western Reserve University (CWRU) graduate program in Systems Biology and Bioinformatics (SYBB) has two tracks:

**Translational Bioinformatics** - The SYBB Track in Translational Bioinformatics poises students to work at the interface of applied 'omics research and clinical medicine. From integrating genomic and functional genomic data into electronic medical records, to developing meta-analysis tools for communicating genomic risk to patients to utilizing this data in personalized medicine. Students trained in the Translational Bioinformatics track to integrate bioinformatics tools and technologies into clinical workflows. Graduates of this training track will find ample opportunities within industry and, as genomics enters the clinical arena, within hospitals, as well.

**Molecular and Computational Biology** - The SYBB Track in Molecular and Computational Biology embraces the pursuit of basic science research, employing the application and development of computational approaches to address difficult questions derived from today's "Big data" derived from 'omics approaches. This track equips students in the acquisition of experimental data utilizing approaches including proteomics, metabolomics, genomics and structural biology and extends this work with interpretation provided by computational analysis. Graduates of this training track will find ample opportunities within the pharmaceutical industry, contract research organizations as well as more traditional academic career paths.

Students can choose either track for both the M.S. and Ph.D. programs.

The SYBB participating departments and centers include:

- Biology
- Biomedical Engineering
- Center for Proteomics and Bioinformatics
- Electrical Engineering and Computer Science
- Epidemiology and Biostatistics
- Genetics and Genome Sciences
- Mathematics
- Nutrition
- Physiology and Biophysics
- Pharmacology

**Program Competencies**

The specific academic requirements of the SYBB Program are intended to provide students with a required core curriculum in Systems Biology and a set of electives designed both to assure minimum competencies in three Fundamental Core Competencies (Biological data, Bioinformatics and Computational Biology, Quantitative Analysis and Modeling) and equip them for their particular thesis research discipline. Each trainee will be guided in their customized course of study by a mentoring committee to ensure the completion of training in the program competencies as well as maintenance of a focus on molecular systems theory.
Masters Degree Plan A Summary

The minimum requirements for the master's degree under Plan A are 21 semester hours of course work plus a thesis equivalent to at least 9 semester hours of registration for 30 hours total. These must include SYBB 501 Biomedical Informatics and Systems Biology Journal Club, and a minimum of 9 hours of SYBB 651 Thesis M.S.. Additional required courses for the Translational Bioinformatics and Molecular and Computational Biology tracks are SYBB 459 Bioinformatics for Systems Biology and SYBB 555 Current Proteomics. The curriculum plan must be approved by the program steering committee and include appropriate coverage of the core competencies in genes and proteins, bioinformatics, and quantitative modeling and analysis. At least 18 semester hours of course work, in addition to thesis hours, must be at the 400-level or higher.

Each student must prepare an individual thesis that must conform to regulations concerning format, quality, and time of submission as established by the dean of graduate studies as well as conforming to the SYBB program guidelines. For completion of master's degrees under Plan A, an oral examination (defense) of the master's thesis is required, where the examination is conducted by a committee of at least three members of the university faculty.

Masters Degree Plan B Summary

The minimum requirements for the master's degree under Plan B are 30 semester hours of course work (with at least 18 semester hours of course work at the 400 level or higher) and a written comprehensive examination or major project with report to be administered and evaluated by the program steering committee. The coursework must include SYBB 501 Biomedical Informatics and Systems Biology Journal Club. Additional required courses for the Translational Bioinformatics and Molecular and Computational Biology tracks are SYBB 459 Bioinformatics for Systems Biology and SYBB 555 Current Proteomics. The curriculum plan must be approved by the program steering committee and include appropriate coverage of the core competencies in genes and proteins, bioinformatics, and quantitative modeling and analysis.

Sample Plan of Study for MS Degree in Molecular and Computational Biology

Plan of Study includes required courses as well as electives.

Plan of Study Grid

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
<td>Spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey of Bioinformatics: Technologies in Bioinformatics (SYBB 411A)</td>
<td>1</td>
<td></td>
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<tr>
<td>Survey of Bioinformatics: Data Integration in Bioinformatics (SYBB 411B)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey of Bioinformatics: Translational Bioinformatics (SYBB 411C)</td>
<td>1</td>
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</tr>
<tr>
<td>Biomedical Informatics and Systems Biology Journal Club (SYBB 501)</td>
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</tr>
<tr>
<td>Statistical Methods I (PQHS 431)</td>
<td>3</td>
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<tr>
<td>Topical Elective from Elective Course List</td>
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<tr>
<td>Survey of Bioinformatics: Programming for Bioinformatics (SYBB 412)</td>
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<td>Current Proteomics (SYBB 555)</td>
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<tr>
<td>Additional 3 Credit Course TBD</td>
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<table>
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<tr>
<th>Second Year</th>
<th>Units</th>
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<th>Spring</th>
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<td>Machine Learning (EECS 440)</td>
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<td>Protein Biophysics (BIOC 475)</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>Systems Biology and Bioinformatics Research (SYBB 601)</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Methods in Structural Biology (BIOC 430)</td>
<td>1 - 6</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Biomedical Informatics and Systems Biology Journal Club (SYBB 501)</td>
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<td></td>
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<tr>
<td>Systems Biology and Bioinformatics Research (SYBB 601)</td>
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<td>Year Total:</td>
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<td>7-12</td>
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</table>

Total Units in Sequence: 37-42

PhD Program Summary

The Systems Biology and Bioinformatics program differs from current CWRU programs in the comprehensive requirement for an understanding of biological systems, bioinformatics, and quantitative analysis & modeling. The program includes a minimal set of required courses including(SYBB 501 Biomedical Informatics and Systems Biology Journal Club) and a course in the Responsible Conduct of research (IBMS 500 On Being a Professional Scientist: The Responsible Conduct of Research). Additional required courses for the Translational Bioinformatics and Molecular and Computational Biology tracks are SYBB 459 Bioinformatics for Systems Biology and SYBB 555 Current Proteomics. At least six additional courses will be required based upon individualized student interests. Other requirements include a qualifier exam, a PhD Dissertation, and oral defense. The total credits required for the PhD is at least 54 credits: 24 graded credits, 12 pre-dissertation research credits, and at least 18 dissertation research credits. Admissions to this program may be obtained through the integrated Biomedical Sciences Training Program (http://casemed.case.edu/bstp), by direct admission to the department or via the Medical Scientist Training Program (http://mstp.case.edu/default.asp).

Sample Plan of Study for PhD Degree

Plan of Study includes required courses as well as electives. Visit www.bioinformatics.case.edu for information regarding Plan of Study for all SYBB Tracks.

Plan of Study Grid for Translational Bioinformatics Track

<table>
<thead>
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<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
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<tr>
<td>Biomedical Informatics and Systems Biology Journal Club (SYBB 501)</td>
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<tr>
<td>Survey of Bioinformatics: Technologies in Bioinformatics (SYBB 411A)</td>
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<tr>
<td>Course</td>
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<tr>
<td>Survey of Bioinformatics: Data Integration in Bioinformatics (SYBB 411B)</td>
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<tr>
<td>Survey of Bioinformatics: Translational Bioinformatics (SYBB 411C)</td>
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<td>Cell Biology I (CBIO 453)</td>
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<td>Statistical Methods I (PQHS 431)</td>
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<tr>
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<td>1-9</td>
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<td></td>
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</tr>
<tr>
<td>Survey of Bioinformatics: Programming for Bioinformatics (SYBB 412)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Proteomics (SYBB 555)</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>Bioinformatics for Systems Biology (SYBB 459)</td>
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<td>Structural Biology (BIOL 434)</td>
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<tr>
<td>On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)</td>
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<tr>
<td>On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)</td>
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**Second Year**

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<tbody>
<tr>
<td>Contemporary Approaches to Drug Discovery (BIOC 528)</td>
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<tr>
<td>A Data-Driven Introduction to Genomics and Human Health (PQHS 451)</td>
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<tr>
<td>Biomedical Informatics and Systems Biology Journal Club (SYBB 501)</td>
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</tr>
<tr>
<td>Systems Biology and Bioinformatics Research (SYBB 601)</td>
<td>3</td>
</tr>
<tr>
<td>Ethical Issues in Genetics/Genomics (BETH 412)</td>
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<tr>
<td>Biomedical Informatics and Systems Biology Journal Club (SYBB 501)</td>
<td>0</td>
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<tr>
<td>Systems Biology and Bioinformatics Research (SYBB 601)</td>
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<tr>
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**Third Year**

<table>
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<tbody>
<tr>
<td>Dissertation Ph.D. (SYBB 701)</td>
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</tr>
<tr>
<td>Dissertation Ph.D. (SYBB 701)</td>
<td>1-9</td>
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<tr>
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<td>1-9</td>
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<tr>
<td>Year Total:</td>
<td>1-9</td>
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**Fourth Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Dissertation Ph.D. (SYBB 701)</td>
<td>1-9</td>
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</tbody>
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**Footnotes**

* Students admitted into program via BSTP would take BSTP 400 for research rotations; students admitted via MSTP would take MSTP 400 for research rotations

**Required Core Courses for the Molecular and Computational Biology and Translational Bioinformatics Tracks of the MS and PhD programs**

**Course List**

- SYBB 459 Bioinformatics for Systems Biology 3
- SYBB 555 Current Proteomics 3
- SYBB 501 Biomedical Informatics and Systems Biology Journal Club 0
- SYBB 601 Systems Biology and Bioinformatics Research 1-18
- SYBB 651 Thesis M.S. (For MS Students only) 1-18
- SYBB 701 Dissertation Ph.D. (For PhD students only) 1-9

**Elective Courses for MS and PhD programs**

**Genes and Proteins Courses**

**Course List**

- SYBB 411A Survey of Bioinformatics: Technologies in Bioinformatics 1
- SYBB 411B Survey of Bioinformatics: Data Integration in Bioinformatics 1
- SYBB 411C Survey of Bioinformatics: Translational Bioinformatics 1
- SYBB 412 Survey of Bioinformatics: Programming for Bioinformatics 3
- PQHS 431 Statistical Methods I 3
- PHOL/CHEM/PHRM/BIOC/NEUR 475 Protein Biophysics 3
- PHOL 456 Conversations on Protein Structure and Function 2
- PHOL 480 Physiology of Organ Systems 4
- CBIO 453 Cell Biology I 3
- CBIO 455 Molecular Biology I 3
- BIOC 452 Nutritional Biochemistry and Metabolism 3
- BIOC 519 Molecular Biology of RNA 3
- BIOC 599 RNA Structure and Function 3
- BIOC 412 Proteins and Enzymes 3
The program in systems biology and bioinformatics offers a flexible curriculum with a minimal number of required classes (SYBB 501), Bioinformatics for Systems Biology (SYBB 459) and Current Proteomics (SYBB 555) are the only required classes; the majority of classes taken toward the MS are tailored to the student’s research interests and thesis project. This flexibility enables students that are interested in pursuing the MS on a part time basis to maximize employee tuition benefits. A CWRU employee (or spouse) has a total of 15 credit hours/year (6 per semester and 3 per summer session) with which to pursue a degree. Taking only this number will net a part time student a MS in 5 semesters and 2 summer sessions; not taking a class during the summer sessions will result in it taking 6 semesters to get the MS; and if a student were to take a single class a semester, it would take 11 semesters to reach the requisite number of classes needed for the MS.

**Bioinformatics and Computational Biology Courses Course List**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL/EECS 419</td>
<td>Applied Probability and Stochastic Processes for Biology</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 451</td>
<td>A Data-Driven Introduction to Genomics and Human Health</td>
<td>3</td>
</tr>
<tr>
<td>PHRM/PHOL/CHEM/BIOL 430</td>
<td>Advanced Methods in Structural Biology</td>
<td>1 - 6</td>
</tr>
<tr>
<td>EECS 458</td>
<td>Introduction to Bioinformatics</td>
<td>3</td>
</tr>
<tr>
<td>NEUR 478/BIOL 378/COGS/MATH 378/BIOL 478/EBME 478</td>
<td>Computational Neuroscience</td>
<td>3</td>
</tr>
<tr>
<td>BIOC 430</td>
<td>Advanced Methods in Structural Biology</td>
<td>1 - 6</td>
</tr>
</tbody>
</table>

**Quantitative Analysis and Modeling Course List**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
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<tr>
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**Part-time SYBB MS program**

The program in systems biology and bioinformatics offers a flexible curriculum with a minimal number of required classes (SYBB Journal club (SYBB 501), Bioinformatics for Systems Biology (SYBB 459) and Current Proteomics (SYBB 555) are the only required classes); the majority of classes taken toward the MS are tailored to the student’s research interests and thesis project. This flexibility enables students that are interested in pursuing the MS on a part time basis to maximize employee tuition benefits. A CWRU employee (or spouse) has a total of 15 credit hours/year (6 per semester and 3 per summer session) with which to pursue a degree. Taking only this number will net a part time student a MS in 5 semesters and 2 summer sessions; not taking a class during the summer sessions will result in it taking 6 semesters to get the MS; and if a student were to take a single class a semester, it would take 11 semesters to reach the requisite number of classes needed for the MS.
CNCR 503. Translational Cancer Research C. 1 Unit.
In this course each Case K12 Paul Calabresi Scholar will present a summary of their experience from attending either the ASCO/AACR or ASH Clinical Trial Protocol Writing Workshop; two sessions will cover how to write a research proposal-hypothesis, specific aims, methods, and study design. Each scholar will write a sample research proposal which will be critiqued by the other members of the class; two sessions will cover the organization and analysis of biostatistic data used in research. One of these sessions will be a working session based on the scholar's own data. The scholars will learn about the essential components and issues in developing a successful career in clinical and translational research. Recommended preparation: Acceptance to Case K12 Clinical Oncology Career Development Training Program as Paul Calabresi Research Scholars.

CNCR 504. Translational Cancer Research D. 1 Unit.
In this course Case K12 Paul Calabresi Scholars will discuss an article on essential components of leadership in an academic and clinical setting; how to advance their clinical research career to the level that they can present at the ASCO national conference; learn how to present research and clinical trials progress orally and written to peers/ faculty for evaluation by making two PowerPoint presentations: one to the class and their two K12 mentors and a second to the K12 CORP Advisory Committee for written evaluation. Both of these sessions will be videotaped and a copy of the tape will be reviewed with the scholar. Each scholar will also provide a written summary of their research and date along with their goals for the next 12 months on April 1. Recommended preparation: Acceptance to Case K12 Clinical Oncology Career Development Training Program as Paul Calabresi Research Scholar.

CRSP Courses
CRSP 401. Introduction to Clinical Research Summer Series. 1 - 3 Units.
This course is designed to familiarize one with the language and concepts of clinical investigation and statistical computing, as well as provide opportunities for problem-solving, and practical application of the information derived from the lectures. The material is organized along the internal logic of the research process, beginning with mechanisms of choosing a research question and moving into the information needed to design the protocol, implement it, analyze the findings, and draw and disseminate the conclusion(s). Prereq: M.D., R.N., Ph.D., D.D.S., health professionals.

CRSP 402. Study Design and Epidemiologic Methods. 3 Units.
This course will cover the methods used in the conduct of epidemiologic and health services research and considers how epidemiologic studies may be designed to maximize etiologic inferences. Topics include: measures of disease frequency, measures of effect, cross-sectional studies, case-control studies, cohort studies, randomized controlled trials, confounding, bias, effect modification, and select topics. Recommended preparation: CRSP 401 or permission of instructor.

CRSP 406. Introduction to R Programming. 2 Units.
This course will provide students with an introduction to R. Major topics will include session management, data objects, reading and writing data, restructuring and combining data frames, handling missing data, working with dates, statistical analysis concepts, and R traditional graphics. Students will learn R programming conventions, how to create, manage and edit R scripts programs, and how to interpret output. Each class will consist of a demo on each lesson followed by a practice session when time permits. Small research datasets will be used both in class examples and in the exercises for each lesson. Students will be expected to complete all homework assignments on time and submit a take-home final exam.

CRSP 407. Logistic Regression and Survival Analysis. 3 Units.
This course will focus on the conceptual understanding and practical application of multivariable modeling in the context of binary and time to event outcomes. Particular emphasis will be placed on model specification, assessment of model assumptions and proper interpretation and visualization of model results. Classes will generally involve a conceptual discussion of the topic in question, followed by a practical application using R statistical software. Planned topics include contingency tables, logistic regression models, Kaplan-Meier curves, Cox proportional hazard models, and sample size estimation for binary and time to event outcomes. Students will be expected to complete biweekly assignments and two course projects involving problem specification, data collection, analysis using R, and a presentation. Prior to taking this course students should have working knowledge of linear regression and its application using R. Students must have the latest software version of R installed on their laptops. Recommended preparation: CRSP 406. Prereq: NURS 630.

CRSP 410. Independent Study in Clinical Research. 1 - 3 Units.
Independent Study in Clinical Research enables the student to undertake study of advanced topics in clinical research that are not offered as standing courses at Case Western Reserve University. The student(s) and a member of the Clinical Research Scholars Program faculty, or another faculty member at CWRU, submit a 1-2 page proposal for independent study to the CRSP Program Director. The proposal should include a descriptive title (e.g., research method or clinical topic area) to be studied; a list of up to 5 student-centered objectives of the study; how the subject matter will be learned; and how success in achieving the objectives will be measured (e.g., manuscript, essay, grant proposal, or other written product; examination, etc.). It is expected that there will be at least one contact hour per week for each credit hour requested.

CRSP 412. Communication in Clinical Research - Grant Writing. 1 Unit.
Written communication is a critical skill in clinical science. We disseminate our work to others through publications, and we obtain the resources to conduct research through grant proposals. This course has been developed for K12 and CRSP scholars. The course focuses on writing grant proposals and, in particular, specific sections of an NIH-style grant. However, the principles discussed in the course apply to any type of proposal. Prereq: CRSP 401 or equivalent.
CRSP 413. Communication in Clinical Research - Oral Presentation, Posters, and the Mass Media. 1 Unit.
To move their work forward, investigators must be able to present their research effectively to both scientific and lay audiences. Although "the written word" is probably the first medium that comes to mind when we think of communication in scientific circles, other modes of communication are also vital. The main objective of this course is to help scholars improve their oral and poster presentation skills, as well as interaction with the mass media. This objective will be achieved through a combination of didactic sessions, readings, and presentations by the students. Prereq: CRSP 401 or equivalent.

CRSP 431. Statistical Methods I. 3 Units.
Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs. First part of year-long sequence. Offered as ANAT 431, BIOL 431, CRSP 431, PQHS 431 and MPH 431.

CRSP 432. Statistical Methods II. 3 Units.
Methods of analysis of variance, regression and analysis of quantitative data. Emphasis on computer solution of problems drawn from the biomedical sciences. Design of experiments, power of tests, and adequacy of models. Offered as BIOL 432, PQHS 432, CRSP 432 and MPH 432. Prereq: PQHS/EPBI 431 or equivalent.

CRSP 440. Translational & Patient-Oriented Research Theory. 3 Units.
Clinical (patient-oriented) and translational science has emerged as a new scientific discipline aimed to accelerate scientific discovery into effective practice. This course provides an overview of the theoretical framework, rationale, process, methodologies, and ethics of clinical and translational research. An integral feature of this course is the participation of a multidisciplinary teaching team, whose expertise and perspective will contribute to providing real-world insights into the complexities of translational and patient-oriented research.

CRSP 450. Seminar in Multidisciplinary Clinical & Translational Research. 0 Unit.
The purpose of this monthly seminar is to introduce students to the processes and challenges of multidisciplinary clinical/translational science, through which discoveries in the laboratory or in early clinical studies are transformed into interventions, treatments, and ultimately, best practices and policies on national and international levels. The seminar will use a case-based approach. Examination of active projects at Case Western Reserve University, Cleveland Clinic Foundation, the MetroHealth Medical Center, University Hospitals Case Medical Center, and the Louis Stokes Veterans Administration Medical Center will enable students to learn first-hand about clinical translational science in action.

CRSP 500. Design and Analysis of Observational Studies. 3 Units.
An observational study investigates treatments, policies or exposures and the effects that they cause, but it differs from an experiment because the investigator cannot control assignment. We introduce appropriate design, data collection and analysis methods for such studies, to help students design and interpret their own studies, and those of others in their field. Technical formalities are minimized, and the presentations will focus on the practical application of the ideas. A course project involves the completion of an observational study, and substantial use of the R statistical software. Topics include randomized experiments and how they differ from observational studies, planning and design for observational studies, adjustments for overt bias, sensitivity analysis, methods for detecting hidden bias, and focus on propensity score methods for selection bias adjustment, including multivariate matching, stratification, weighting and regression adjustments. Recommended preparation: a working knowledge of multiple regression, some familiarity with logistic regression, with some exposure to fitting regression models in R. Offered as CRSP 500 and PQHS 500.

CRSP 501. Team Science - Working in Interdisciplinary Research Teams. 1 Unit.
This course will assist learners to understand how different professional disciplines, each representing a body of scientific knowledge, can best work together to develop and disseminate translational knowledge. Learners will develop a set of skills specific to be an effective member and leader of an interdisciplinary research team, including working with different value and knowledge sets across disciplines, understanding the mental models of other disciplines, creating shared mental models, running effective meetings, managing conflict, giving and receiving feedback, and group decision making techniques. Using the small group seminar approach and case studies, learners will practice individual and group communication, reflective and self-assessment techniques, and engage in experiential learning activities regarding effective teamwork in interdisciplinary research teams. Techniques to increase group creativity and frame new insights will be discussed.

CRSP 502. Leadership Skills for Clinical Research Teams. 2 Units.
Leadership Assessment and Development is for participants to learn a method for assessing their knowledge, abilities, and values relevant to management; and for developing and implementing plans for acquiring new management related knowledge and abilities. The major goals of this course include generating data through a variety of assessment methods designed to reveal your interests, abilities, values, and knowledge related to leadership effectiveness; learning how to interpret this assessment data and use it to design/plan developmental activities; small group sharing of insights from the various assessments. Recommended preparation: K grant appointment or consent of instructor.

CRSP 503. Innovation and Entrepreneurship. 1 Unit.
The purpose of this module is to acquaint and ultimately engage clinical researchers with the business of innovation and entrepreneurship. Goals include: (1) to provide researchers with many of the skills that they would need to translate academic research into commercial use; (2) to sensititize clinical researchers to the goals of the business community and facilitate their ability to work with the private sector on technology development; and (3) to make clinical researchers aware of the processes of academic technology development and transfer. Sessions consist of a lecture and case discussion facilitated by one of the co-directors.
CRSP 504. Managing Research Records - A System's Approach. 2 - 3 Units.
This course will provide an approach to managing data for research studies. Major topics include a discussion of a research study system including database design and development, data management, and clinical data management; how to evaluate the data needs of a study including the impact of required regulations; summary of key regulations; the role of the data manager including protocol review, development of a data management plan, CRF design, data cleaning, locking studies and ensuring best practices. Each session will include a lecture, class discussion, and student presentation.

CRSP 505. Investigating Social Determinants of Health. 2 - 3 Units.
The biopsychosocial model highlights the inter-related roles that biological, psychological, and social factors play in health and illness. This course is geared towards clinical research scholars who would like to incorporate aspects of the "social context" in their research. The course will examine the conceptualization, measurement, and effects of several key socio-cultural determinants of health and illness. Sample studies that incorporate social determinants of health will be reviewed. The course will also consider strategies and techniques to conduct clinical research involving social factors in socially and ethnically diverse settings. Students will be encouraged to develop a prototypical study design to incorporate social determinants in their research. To earn an optional third credit hour for this course, students will be required to complete additional assignments tailored to the students' research needs and interests upon mutual agreement with the instructor at the beginning of the course. Recommended preparation: CRSP 401.

CRSP 510. Health Disparities. 3 Units.
This course aims to provide theoretical and application tools for students from many disciplinary backgrounds to conduct research and develop interventions to reduce health disparities. The course will be situated contextually within the historical record of the United States, reviewing social, political, economic, cultural, legal, and ethical theories related to disparities in general, with a central focus on health disparities. Several frameworks regarding health disparities will be used for investigating and discussing the empirical evidence on disparities among other subgroups (e.g., the poor, women, uninsured, disabled, and non-English speaking populations) will also be included and discussed. Students will be expected to develop a research proposal (observational, clinical, and/or intervention) rooted in their disciplinary background that will incorporate materials from the various perspectives presented throughout the course, with the objective of developing and reinforcing a more comprehensive approach to current practices within their fields. Offered as CRSP 510, PQHS 510, MPHP 510, NURS 510, and SASS 510.

CRSP 550. Meta-Analysis & Evidence Synthesis. 2 - 3 Units.
Systematic reviews use reproducible methods to systematically search the literature and synthesize the results of a specific topic area. Meta-analysis is a specific analytic technique used to pool results of individual studies. Systematic reviews are useful ways to establish one's knowledge in a particular field of study, and can highlight gaps in research which can be pursued in future work. They can also inform the background of a grant. This course is designed to introduce students to the methods of conducting a high quality systematic review and meta-analysis of intervention studies. We will cover the design, methods, and analytic techniques involved in systematic reviews. These concepts will prepare students to conduct their own systematic review or evaluate the systematic reviews of others. Sessions will be lectures, labs, and presentations. Topics include developing a search strategy, abstracting key data, synthesizing the results qualitatively, meta-analytic techniques, grading the quality of studies, grading the strength of the evidence, and manuscript preparation specific to systematic reviews and meta-analysis of intervention studies. Caveat: If you would like to conduct a systematic review of your own that can be published after the course ends, you will need to have several other class members or colleagues willing to work with you on the project. The systematic review should be on a topic where you expect no more than 20-30 included studies in order to be able to complete the review soon after the course ends. Offered as CRSP 550 and PQHS 550. Prereq: CRSP 401, PQHS/EPBI 431, MPHP 405, NURS 532 or Requisites Not Met permission.

CRSP 601. Research Practicum. 1 - 9 Units.
Research practicum and/or laboratory rotation.

CRSP 603. Research Ethics and Regulation. 1 - 2 Units.
This course is designed to introduce students to the ethical, policy, and legal issues raised by research involving human subjects. It is intended for law students, post-doctoral trainees in health-related disciplines and other students in relevant fields. Topics include (among others): regulation and monitoring of research; research in third-world nations; research with special populations; stem cell and genetic research; research to combat bioterrorism; scientific misconduct; conflicts of interest; commercialization and intellectual property; and the use of deception and placebos. Course will meet once per week for 2 hours throughout the semester. Grades will be given based on class participation and a series of group projects and individual short writing assignments. Offered as BETH 503, CRSP 603 and LAWS 5225.

CRSP 651. Clinical Research Scholars Thesis. 1 - 18 Units.
CRSP Thesis M.S.

CRSP 701. Dissertation Ph.D.. 1 - 9 Units.
Ph.D. Dissertation credits. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

INTH Courses

INTH 301. Fundamentals of Global Health. 3 Units.
This course seeks to integrate the multiple perspectives and objectives in global health by investigating how the disciplines of Biology, Medicine, Anthropology, Nursing, Mathematics, Engineering analyze and approach the same set of international health problems. Students will develop a shared vocabulary with which to understand these various perspectives from within their own discipline. The focus sites will emphasize issues related to the health consequences of development projects, emergency response to a health care crisis and diseases of development in presence of underdevelopment. Offered as INTH 301 and INTH 401. Prereq: Junior or senior.
INTH 315. Water Security and Social Justice in Brazil. 3 Units.
CWRU, through the Center for Global Health and Diseases, has had projects, student exchanges and courses with institutions in Brazil and especially with the state of Bahia for over 30 years. In that time, personal and professional relationships have been developed with branches of the Ministry of Health (Oswaldo Cruz Foundation, the Municipal and State Health Departments), the Federal University of Bahia, and the Bahiana School of Medicine and Public Health. Brazil is the second largest country in the Western Hemisphere and the 7th or 8th largest economy in the world. There are more people who speak Portuguese in South America than Spanish. Despite newly discovered oil, enormous natural and human resources, development in Brazil has been uneven with the Northeast remaining the least developed. The Northeastern state of Bahia ranked 22nd out of 27 states on the UN’s Index of Human Development (http://www.pnud.org.br/IDH/DH.aspx# and http://www.atlasbrasil.org.br/2013/pt/home/). The State capital, Salvador, ranks 4590 out of 5565 municipalities. Even with large social inequities and health care disparities, the Brazilian government and society have produced remarkable social policies, have shown a willingness to implement these policies and have the resources to significantly improve the lives of its most impoverished citizens. Critical basic infrastructure for health and development is water. Its consumption is essential; it is a mechanism for waste disposal, industry and agriculture are dependent on its supply. The problem of water quantity and quality are common all human societies (witness the drought in California and the burning Cuyahoga). Individuals from all walks of life will need to assess issues of water at some time, from doctors, engineers, urban planners, lawyers and politicians. In Brazil the issues of water are more exposed and easier to examine on different scales than in the U.S. The problem also resides within a social, health care, and political context that compares well and at the same time contrasts sharply with that of the USA. As a student in this course, you will gain first-hand knowledge of the social and public health challenges regarding water security in Brazil. Through field experiences in the capital city of Salvador and the rural town of Ubaíra, you will immerse yourself in interdisciplinary perspectives on the public health, scientific, political, and bioethical dimensions of water security in Brazil. This immersive experience will be facilitated by faculty from the CWRU Dept. of Bioethics and the Center for Global Health and Diseases, the Brazilian Ministry of Health, the Federal University of Bahia, the Bahiana School of Medicine and Public Health, and Brazilian graduate student participants. Offered as: INTH 315, INTH 415, BETH 315H, and BETH 415H. Counts for CAS Global & Cultural Diversity Requirement.

INTH 401. Fundamentals of Global Health. 3 Units.
This course seeks to integrate the multiple perspectives and objectives in global health by investigating how the disciplines of Biology, Medicine, Anthropology, Nursing, Mathematics, Engineering analyze and approach the same set of international health problems. Students will develop a shared vocabulary with which to understand these various perspectives from within their own discipline. The focus sites will emphasize issues related to the health consequences of development projects, emergency response to a health care crisis and diseases of development in presence of underdevelopment. Offered as INTH 301 and INTH 401. Prereq: Graduate student.
INTH 447. Global Health: Outbreak Investigation in Real-Time. 3 Units.
This course provides a trans-cultural, trans-disciplinary, multimedia learning experience by analyzing historical and real-time data from the annual dengue endemics and sporadic epidemics in Puerto Rico and Brazil. A rigorous problem-centered training in the epidemiology, prevention, treatment, and control of infectious diseases using real-time and historical surveillance data of endemic and epidemic Dengue in Bahia, Brazil. This is an advanced epidemiology course in which core material will be primarily taught through reading assignments, class discussion, group projects, and class presentations. The course will utilize the online web-based communication and learning technology to create a single classroom between the CWRU and international partners with unique and complementary skills. In addition to joint classroom lectures across sites, student groups will also perform smaller-scale videoconference meetings for assigned group projects, thus creating strong international connections for the students, faculty, and our institutions. Note: Due to the complexities of time zones for this international course, the course will begin at 8:00a.m. until the U.S.A. adjusts clocks for Daylight Savings Time (unlike Brazil). Therefore, classes after the second week of March will begin at 9:00a.m. Offered as PQHS 447, INTH 447 and MPHP 447.

INTH 484. Global Health Epidemiology. 1 - 3 Units.
This course provides a rigorous problem-centered training in the epidemiology, prevention, treatment, and control of infectious diseases and, more generally, global health. This is an advanced epidemiology that embraces an active learning environment. Students are expected to invest time out of the classroom reading and working with classmates. Classes will be conducted with discussions, debates, group projects, and group presentations. By taking this course, students will develop a framework for interpreting, assessing, and performing epidemiologic research on issues of global importance. The course will be divided into three modules: 1) Global Health Epidemiology 2) Helminth Epidemiology, and 3) Epidemiology of Disease Elimination. Each module is worth 1 credit hour and may be taken separately. Each module will have a separate project and/or exam. The final exam time will be used for group presentations and panel discussion. Active class participation is required through discussions, case studies, and group projects. Offered as PQHS 484, INTH 484, and MPHP 484.

INTH 494. Infectious Disease Epidemiology. 3 Units.
This course focuses on tuberculosis (TB) and HIV epidemiology, including perspectives on these diseases in the US and globally. It is a follow-up to PQHS/MPHP 484: Global Health Epidemiology, but these courses do not necessarily need to be taken in sequence. This is an advanced course, focusing on methods and approaches in epidemiology and public health. Offered as PQHS 494, INTH 494 and MPHP 494. Prereq: PQHS/EPBI 490.

INTH 551. World Health Seminar. 1 Unit.
This seminar series examines a broad range of topics related to infectious disease research in international settings. Areas of interest are certain to include epidemiology, bioethics, medical anthropology, pathogenesis, drug resistance, vector biology, cell and molecular biology, vaccine development, diagnosis, and socio-cultural factors contributing to or compromising effective health care delivery in endemic countries. Additionally we will discuss intellectual property policies on global access to medical innovations. Topics will also include neglected diseases and the interactions between these diseases with HIV and malaria infections. Speakers will include a diverse group of regional faculty and post-doctoral trainees, as well as visiting colleagues from around the world. Students will be asked to read a journal article written by the speaker and then discuss this article with the speaker after their seminar.

PAST Courses

PAST 401. Foundations of Clinical Medicine-Principles of Interviewing. 3 Units.
The general purpose of this course is to teach the physician assistant student the skills necessary to conduct a clinical/medical interview with a patient and to be able to present the information to other health care professionals in both an oral and written form. This course, which is designed as small, group seminars, will focus on the skills necessary to question patients in a directed fashion and to listen to the patient with concern and empathy. Instruction will emphasize what data is needed in a complete medical history as well as the focused interview, the proper technique for gathering information, and the format for presentation of the data. Instructional techniques will include role-playing, small group discussion, and observation and critique by instructors, other students and simulated patient models. Prereq: Students must be in Physician Assistant Program.

PAST 402. Physical Diagnosis. 4 Units.
This lecture/discussion/laboratory course presents and explores the techniques for performing a complete and competent physical examination, understanding the pathophysiology presented by the patient, and organizing and reporting the findings in both written and oral format. Synthesis of historical and physical presentations for an accurate evaluation of the patient will be emphasized. The problem-oriented physical examination and special examination tools and techniques will be presented. Instructional techniques will include small group discussion, practical experience with other students and faculty, and the observation and critique of physical examination skills by faculty. Prereq: Students must be in Physician Assistant Program.

PAST 403. Diagnostic Methods-Clinical Lab. 1 Unit.
This course is designed to introduce the student to clinical laboratory medicine. Lectures are designed to review the various types of laboratory tests, acquisition and handling of specimens, normal values as well as interpretation of results and correlation with clinical conditions. Prereq: Students must be in Physician Assistant Program.

PAST 404. Clinical Correlations. 1 Unit.
This seminar course places emphasis on internal organs with clinical correlation to anatomic conditions. Content will include basis concepts of genetics, embryology, the comparison of normal and abnormal structural relationships and the demonstration of how these things relate to health and disease. Students will review on-line genetics learning modules and meet in small seminar groups to review anatomical clinical correlates. Prereq: Students must be in Physician Assistant Program.

PAST 405. Medical Microbiology & Infectious Disease. 2 Units.
This course is the study of microorganisms and the diseases they cause in man. It includes consideration of infectious disease microorganisms including their biochemical, serological and virulence characteristics, and clinical manifestations. An organ system approach is used to examine the fundamentals of pathogenicity, host response, epidemiological aspects of infectious disease, as well as clinical manifestations, diagnosis and treatment of infections with clinical correlations. Prereq: Students must be in Physician Assistant Program.
PAST 406. Ethics in Healthcare Delivery. 1 Unit.
This course is an overview of the discipline of medical ethics presenting the study and application of relevant principles, insights, and understandings of modern medical practice. The course includes a brief overview of ethical theories which lay the foundation for subsequent investigation into specific ethical problems found in medical science and technology. The purpose of the course is to provide a framework which enables the student to reason clearly and effectively about the ethics involved in medical science and technology. The course assumes no prior knowledge of philosophical ethics or medical science. A framework of ethical decision making is introduced and practiced using realistic medical cases via a Medical Ethics Committee. Prereq: Students must be in Physician Assistant Program.

PAST 407. Clinical Procedures. 4 Units.
The purpose is to prepare future clinicians for clinical management of health and disease by preparing them for common clinical procedures. These will include basic and advanced surgical skills, basic laboratory skills, common outpatient procedures, common emergency procedures, and interpretation of electrocardiographs and common radiologic tests. Prereq: Students must be in Physician Assistant Program.

PAST 410. Cadaver dissection-based human anatomy with histology and physiologic correlations. 6 Units.
This course will provide students with a sound understanding of the normal human body as a foundation for subsequent pursuit of biomedical careers. A combination of daily lectures and laboratories integrates cadaver dissection-based gross anatomy with the associated histology, embryology, neuroanatomy and basic physiology. This course is well-suited to all biomedical careers, including pre-clinical and biomedical undergraduates, post-baccalaureate, pre-clinical master of science graduate programs, plus medical and dental students seeking additional training in the anatomical sciences. It will meet any of the anatomy-oriented prerequisites being implemented for medical and dental school applications, including those preferring or requiring a cadaver-based experience. The assessments will include a combination of written and cadaver-based practical questions. Offered as ANAT 410 and PAST 410. Prereq: Students must be in Physician Assistant Program.

PAST 411. Professional Issues for PA's-History & Roles of the PA I. 1 Unit.
This one semester course explores through lecture and discussion the factors affecting the development of the profession and role socialization with emphasis on history, regulations and organizations governing PA practice. An overview of clinical responsibilities, team based practice, population health and the PAs role, licensing and credentialing practices will be presented and discussed. Prereq: Students must be in Physician Assistant Program.

PAST 412. Professional Issues for Physician Assistants II. 2 Units.
In this three course series students will explore factors affecting the development of the profession, the status of the PA in the U.S. healthcare system and current issues in clinical practice including practice-based improvement and systems-based practice. Through lecture and discussion, this series prepares the student for the transition from classroom to clinical training and clinical practice. Emphasis is given to the responsibilities that come with being a professional, professionalism and practicing quality improvement. Prereq: Students must be in Physician Assistant Program.

PAST 413. Professional Issues for Physician Assistants III. 2 Units.
In this three course series students will explore factors affecting the development of the profession, the status of the PA in the U.S. healthcare system and current issues in clinical practice including practice-based improvement and systems-based practice. Through lecture and discussion, this series prepares the student for the transition from classroom to clinical training and clinical practice. Emphasis is given to the responsibilities that come with being a professional, professionalism and practicing quality improvement. Prereq: Students must be in Physician Assistant Program.

PAST 420. Pharmacology I. 2 Units.
In this two course series, (PAST 421 Pharmacology II) students will be provided with a basic introduction to the principles of pharmacology and to drug classes of particular relevance to the physician assistant. Information concerning drug doses and calculations used in determining doses will be included in this course and PAST 421 Pharmacology. Prereq: Students must be in Physician Assistant Program.

PAST 421. Pharmacology II. 3 Units.
In this two course series (PAST 420 Pharmacology), physician assistant students will be provided with foundational knowledge of the therapeutic uses and effects of drugs. The indications, contraindications and adverse effects of prototypical drugs are covered. Drug dependence and addiction are also discussed. This course also includes a problem-based learning component which will enhance students’ teamwork and clinical reasoning skills by examining and analyzing case scenarios in small groups. Prereq: Students must be in Physician Assistant Program.

PAST 430. Principles of Internal Medicine. 7 Units.
This one semester lecture/discussion course provides students with a detailed study of the etiology, pathophysiology, signs, symptoms, diagnosis and treatment of various disorders encountered in internal medicine. A broad array of diseases in cardiology, dermatology, endocrinology, gastroenterology, gerontology, hepatology, hematology, oncology, urology, nephrology, neurology, pulmonology and rheumatology are explored. Prereq: Students must be in Physician Assistant Program.

PAST 431. Principles of Clinical Medicine-Surgery & Emergency Medicine. 4 Units.
This one semester course presents the fundamentals of surgical disease and care of the acutely injured and ill patients. The purpose is to familiarize the student with the etiology, anatomy, pathophysiology, clinical manifestations and appropriate diagnosis and treatment of selected surgical conditions and conditions encountered in the surgical subspecialty and emergency medical settings. Prereq: Students must be in Physician Assistant Program.

PAST 432. Principles of Clinical Medicine-OB/GYN. 3 Units.
This lecture/case presentation course gives the student an overview of commonly encountered obstetric and gynecologic disorders. Anatomy and physiology of the human reproduction system are examined, including the changes in pregnancy, prenatal care, medical and surgical complications of pregnancy, pre- and postpartum care. Common gynecologic conditions, methods and effectiveness of contraception, cancer detection methods and the diagnosis and treatment of sexually transmitted infections in the female are explored. Prereq: Students must be in Physician Assistant Program.
PAST 433. Principles of Clinical Medicine-Pediatrics. 3 Units.
This course introduces the student to a unique, complex and challenging field of pediatrics. It emphasizes aspects of general pediatrics and provides a foundation for those students who elect to further study the health care of infants, children and adolescents. This course addresses issues unique to childhood and adolescence by focusing on human developmental biology, and by emphasizing the impact of family, community, and society on child health and well-being. Additionally, it focuses on the impact of disease and its treatment on the developing human, and emphasizes growth and development, principles of health supervision, and recognition of common health problems. Prereq: Students must be in Physician Assistant Program.

PAST 434. Principles of Clinical Medicine-Behavioral Medicine. 2 Units.
This one semester course gives students an overview of some of the most important areas in behavioral psychiatry. This course is an overview of basic psychiatric concepts and focuses on assessing patients who manifest psychological symptoms. Topics include diagnosis and treatment of anxiety disorders, mood disorders, common child and adolescent disorders, somatoform and factitious disorders, psychotic disorders, sleep disorders, adjustment and personality disorders, and drug and alcohol abuse and addresses forensic issues in behavioral health. Prereq: Students must be in Physician Assistant Program.

PAST 440. Pre-Clinical Clerkships I. 1 Unit.
This course/clerkship provides the student with clinical experience at clinical sites in the didactic year utilizing what was learned in Foundations of Clinical Medicine (Interviewing and Physical Diagnosis class/lab). During the pre-clinical time at program designated sites, students will continue to develop and apply their history and physical exam skills, interpersonal skills, oral presentation and medical documentation skills. For expanding skills and creating relationships within the community, this course also encompasses community service, experiential learning and interprofessional education activities. This course/clerkship will help to better prepare students to gain experience and develop confidence in approaching patients prior to entering the clinical year. Prereq: Students must be in Physician Assistant Program.

PAST 441. Pre-Clinical Clerkships II. 1 Unit.
This course/clerkship provides the student with clinical experience at clinical sites in the didactic year utilizing what was learned in Foundations of Clinical Medicine (Interviewing and Physical Diagnosis class/lab). During the pre-clinical time at program designated sites, students will continue to develop and apply their history and physical exam skills, interpersonal skills, oral presentation and medical documentation skills. For expanding skills and creating relationships within the community, this course also encompasses community service, experiential learning and interprofessional education activities. This course/clerkship will help to better prepare students to gain experience and develop confidence in approaching patients prior to entering the clinical year. Prereq: Students must be in Physician Assistant Program.

PAST 451. Introduction to Public Health. 1 Unit.
This course will introduce students to concepts of public health and provide experience in public health by completion of a mentored project with a local health department. The course will enhance the student's knowledge of the history and philosophy of public health, the Healthy People 2020 initiatives and the social determinants of health and how they can be impacted. Teaching methodologies will include online modules from the Association for Prevention Teaching and Research and discussion along with the mentored public health project. Prereq: Students must be in Physician Assistant Program.

PAST 452. Introduction to Evidence Based Medicine. 2 Units.
This course is intended to provide learners with a basic understanding of the principles of epidemiology, biostatistics and evidence-based medicine. The course involves analysis of prospective and retrospective studies, cross-sectional studies and experimental epidemiology. It will focus on epidemiological scenarios that relate to both infectious disease and chronic disease. In addition, the course will provide the student with a basic understanding of the application of statistical techniques to the biological and health sciences and to demonstrate their areas of application. Emphasis will be placed on probability laws, sampling and parameter estimation, test of hypothesis, correlation, regression and analysis of variance. Finally, students will be introduced to the basic concepts of evidence-based medicine, information mastery, and critical appraisal of the medical literature. Prereq: Students must be in Physician Assistant Program.

PAST 453. Medical Spanish Elective. 1 Unit.
This course will teach students the basics of Spanish as it applies to the medical field such as physical examinations, emergencies, common diseases within the Latino population, and specializations. By familiarizing students with conversational Spanish and medical Spanish, this course will enable students to apply their learning to real-world situations, to assist in communications, and ultimately to break down the barrier between doctors and patients. Prereq: Students must be in Physician Assistant Program.

PAST 454. Research Methods Elective. 1 Unit.
This lecture course introduces students to research design and scientific inquiry and provides them with the skills necessary for interpretation and critical evaluation of the medical literature. It includes a brief review of important statistical principles and methods and their application to problems in medicine and health. Prereq: Students must be in Physician Assistant Program.

PAST 477. Human Physiology. 4 Units.
This lecture/seminar experience is meant to enhance the students fundamental knowledge in human physiology with an emphasis on physiologic concepts in relationship to health, disease and illnesses. The course will provide students with an understanding of the function, regulation and integration of the major organ systems. Offered as PAST 477 and PHOL 477. Prereq: Students must be in Physician Assistant Program.
PAST 500. Clinical Residency: Emergency Medicine Rotation. 3 Units.
This clinical rotation is designed to expose the student to the wide variety of problems encountered in the hospital-based emergency room setting in both the fast track and acute care sides of the emergency department. The rotation experience includes the medical/surgical management of patients of all ages (infant to geriatric) with presenting problems that may be of a life threatening nature. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a history and physical exam, interpretation of diagnostic testing, and the development of a plan. The student will also be exposed to and perform diagnostic and therapeutic procedures. These experiences will be under appropriate supervision. Prereq: Students must be in Physician Assistant Program.

PAST 501. Clinical Residency: Family Medicine. 3 Units.
This clinical rotation is designed to give the student an understanding of family medicine/primary care medicine as practiced in office and/or clinic in an outpatient setting. The student will work with patients from a variety of social, economic and cultural backgrounds across the lifespan. They will experience continuity of care while assessing, diagnosing, monitoring, managing, referring and educating patients. The student will be exposed to both acute and chronic problems as well as the psychosocial problems that are encountered in this setting. Students may encounter and participate in the care of patients of all ages: pediatric, adolescent, adult and geriatric populations. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Prereq: Students must be in Physician Assistant Program.

PAST 502. Clinical Residency: Geriatrics. 3 Units.
This clinical rotation is designed to give the student an understanding of geriatric medicine. The understanding of the many and varied medical and psychosocial problems in geriatric patients is accomplished via the accurate collection of data through a complete history and physical examination, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Teaching rounds and lectures may be used to introduce concepts of geriatric medicine. Prereq: Students must be in Physician Assistant Program.

PAST 503. Clinical Residency: Internal Medicine Rotation. 3 Units.
This clinical rotation is designed to provide the student with an understanding of the wide variety of problems encountered in hospital-based internal medicine. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problems. Students are assigned to medical teams during their rotation. Teaching rounds and lectures are used to introduce concepts of internal medicine. Prereq: Students must be in Physician Assistant Program.

PAST 504. Clinical Residency: Obstetrics & Gynecology. 3 Units.
This clinical rotation is designed to expose the student to the variety of problems encountered in women's health care. The focus of the learning experience is on recognition and management of common gynecological illnesses, sexually transmitted infections, family planning, birth control, and cancer of the female reproductive system and breast. Obstetrical focus is on pregnancy, labor and delivery, and postpartum care. The student will also have an exposure to the surgical management of gynecological and obstetric problems. Teaching rounds and lectures may be used to introduce concepts of obstetrics and gynecology. Prereq: Students must be in Physician Assistant Program.

PAST 505. Clinical Residency: Pediatrics. 3 Units.
This clinical rotation is designed to emphasize care of the child from birth to adolescence. The focus of the learning experience is on recognition and management of common childhood illnesses, assessment of variations of normal growth and development, and the counseling of parents regarding immunizations, preventative health care visits, growth and development, nutrition, injury prevention and common psychosocial problems. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Teaching rounds and lectures may be used to introduce concepts of pediatrics. Prereq: Students must be in Physician Assistant Program.

PAST 506. Clinical Residency: Behavioral and Mental Health. 3 Units.
This clinical rotation is designed to give the student an understanding of the psycho-social and behavioral components of health, disease, and disability. The student will be exposed to a variety of mental illnesses and disabilities and will also be able to recognize and categorize psychiatric disorders along with the therapeutic modalities used in their treatment. The formulation and understanding of the varied psychiatric problems is accomplished via the accurate collection of data through a complete history and mental status exam, interpretation of diagnostic testing when appropriate, formulation of a problem list, and the development of a plan for each presenting problem. Emphasis is placed on early recognition, intervention, and psychiatric referral and/or consultation. Teaching rounds and lectures are used to introduce concepts of psychiatric medicine. Prereq: Students must be in Physician Assistant Program.

PAST 507. Clinical Residency: Surgery. 3 Units.
This clinical rotation is designed to expose the student to the varied population with surgically manageable disease from adolescence to geriatrics. The formulation and understanding of the varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan. The focus of the learning experience is on the pre-operative evaluation and preparation of the patients for surgery, procedures and assisting during the intra-operative period, and the care of patients post-operatively. The student will be exposed to both emergent and non-emergent surgical management of patients. The student may be assigned to surgical teams during his/her rotation. Teaching rounds and lectures are used to introduce concepts of surgical care. Prereq: Students must be in Physician Assistant Program.
PAST 508. Clinical Residency: Primary Care Elective. 3 Units.
This clinical rotation is designed to give the student an understanding of family medicine/primary care medicine as practiced in office and/or clinic in an outpatient setting. The student will work with patients from a variety of social, economic and cultural backgrounds across the lifespan. They will experience continuity of care while assessing, diagnosing, monitoring, managing, referring and educating patients. The student will be exposed to both acute and chronic problems as well as the psychosocial problems that are encountered in this setting. Students may encounter and participate in the care of patients of all ages: pediatric, adolescent, adult and geriatric populations. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Prereq: Students must be in Physician Assistant Program.

PAST 509. Clinical Residency: Inpatient Medicine Elective. 3 Units.
This clinical rotation is designed to provide the student with an understanding of the wide variety of problems encountered in hospital-based internal/surgical medicine. The formulation and understanding of the many and varied medical and/or surgical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Students are assigned to medical teams during their rotation. Teaching rounds and lectures are used to introduce concepts of hospital based medicine. Prereq: Students must be in Physician Assistant Program.

PAST 510. Clinical Residency: Elective. 3 Units.
This elective clinical rotation is designed to provide the student with the knowledge and skills in an area of interest. Students will gain an understanding of the variety of problems encountered in a medical or surgical sub-specialty discipline. The formulation and understanding of the many and varied medical and/or surgical sub-specialty problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem including pharmacologic and non-pharmacologic management. Acquisition of these skills helps facilitate the PA student to progress through the clinical rotation with increasing complexity of clinical experiences, building confidence, competence and compassion. In addition to gaining clinical skills specific to the specialty of the rotation, the student will also continue to develop skills in systematic medical problem solving and patient management abilities, establish or reinforce patterns of independent learning, self-evaluation, interprofessional relationships and communication skills. Elective rotation sites are chosen based on practice characteristics that are important for the PA student within this rotation. These may include practice location, patient populations, and availability of specific experiences and procedures. Prereq: Students must be in Physician Assistant Program.

PAST 511. Clinical Residency: Elective. 3 Units.
This elective clinical rotation is designed to provide the student with the knowledge and skills in an area of interest. Students will gain an understanding of the variety of problems encountered in a medical or surgical sub-specialty discipline. The formulation and understanding of the many and varied medical and/or surgical sub-specialty problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem including pharmacologic and non-pharmacologic management. Acquisition of these skills helps facilitate the PA student to progress through the clinical rotation with increasing complexity of clinical experiences, building confidence, competence and compassion. In addition to gaining clinical skills specific to the specialty of the rotation, the student will also continue to develop skills in systematic medical problem solving and patient management abilities, establish or reinforce patterns of independent learning, self-evaluation, interprofessional relationships and communication skills. Elective rotation sites are chosen based on practice characteristics that are important for the PA student within this rotation. These may include practice location, patient populations, and availability of specific experiences and procedures. Prereq: Students must be in Physician Assistant Program.

SYBB Courses
SYBB 201R. Basic Statistics for Social and Life Sciences Using R Programming. 3 Units.
Designed for undergraduates in the social sciences and life sciences who need to use statistical techniques in their fields. Descriptive statistics, probability models, sampling distributions. Point and confidence interval estimation, hypothesis testing. Elementary regression and analysis of variance. Not for credit toward major or minor in Statistics. Students may earn credit for only one of the following courses: STAT 201, STAT 201R, ANTH 319, PSCL 282 or SYBB 201R. Offered as STAT 201R and SYBB 201R.
SYBB 311A. Survey of Bioinformatics: Technologies in Bioinformatics. 1 Unit.
SYBB 311A/411A is a 5-week course that introduces students to the high-throughput technologies used to collect data for bioinformatics research in the fields of genomics, proteomics, and metabolomics. In particular, we will focus on mass spectrometer-based proteomics, DNA and RNA sequencing, genotyping, protein microarrays, and mass spectrometry-based metabolomics. This is a lecture-based course that relies heavily on out-of-class readings. Graduate students will be expected to write a report and give an oral presentation at the end of the course.

SYBB 311A/411A is part of the SYBB survey series which is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of bioinformatics - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming skills. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311A, BIOL 311A and SYBB 411A. Prereq: (BIOL 214 and BIOL 215) or BIOL 250. Coreq: SYBB 311B, SYBB 311C, and SYBB 311D.

SYBB 311B. Survey of Bioinformatics: Data Integration in Bioinformatics. 1 Unit.
SYBB 311B/411B is a five week course that surveys the conceptual models and tools used to analyze and interpret data collected by high-throughput technologies, providing an entry points for students new to the field of bioinformatics. The knowledge structures that we will cover include: biomedical ontologies, signaling pathways, and interaction networks. We will also cover tools for genome exploration and analysis. The SYBB survey series is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311A, BIOL 311A and SYBB 411A. Prereq: (BIOL 214 and BIOL 215) or BIOL 250. Coreq: SYBB 311B, SYBB 311C, and SYBB 311D.

SYBB 311C. Survey of Bioinformatics: Translational Bioinformatics. 1 Unit.
SYBB 311C/411C is a longitudinal course that introduces students to the latest applications of bioinformatics, with a focus on translational research. Topics include: ‘omic drug discovery, pharmacogenomics, microbiome analysis, and genomic medicine. The focus of this course is on illustrating how bioinformatic technologies can be paired with data integration tools for various applications in medicine. The course is organized as a weekly journal club, with instructors leading the discussion of recent literature in the field of bioinformatics. Students will be expected to complete readings beforehand; students will also work in teams to write weekly reports reviewing journal articles in the field. The SYBB survey series is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311C, BIOL 311C and SYBB 411C. Prereq: (BIOL 214 and BIOL 215) or BIOL 250. Coreq: SYBB 311A, SYBB 311B, and SYBB 311D.

SYBB 312R. Basic Statistics for Engineering and Science Using R Programming. 3 Units.
For advanced undergraduate students in engineering, physical sciences, life sciences. Comprehensive introduction to probability models and statistical methods of analyzing data with the object of formulating statistical models and choosing appropriate methods for inference from experimental and observational data and for testing the model's validity. Balanced approach with equal emphasis on probability, fundamental concepts of statistics, point and interval estimation, hypothesis testing, analysis of variance, design of experiments, and regression modeling. Note: Credit given for only one (1) of STAT 312, STAT 312R, STAT 313, STAT 333, STAT 433 or SYBB 312R. Offered as STAT 312R and SYBB 312R. Prereq: MATH 122 or equivalent.
SYBB 319. Applied Probability and Stochastic Processes for Biology. 3 Units.
Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419. Prereq: MATH 224 or MATH 223 and BIOL 300 or BIOL 306 and MATH 201 or MATH 307 or consent of instructor.

SYBB 322. Clinical Informatics at the Bedside and the Bench (Part II). 3 Units.
This course is part of a two semester series that provides student with an overview of the field of clinical informatics and its research applications. SYBB 422 focuses on the use of informatics in public health, epidemiology, and translational bioinformatics; topics include: pharmacosurveillance, comparative effectiveness research, and personalized medicine. Through lectures and in-depth readings of literature in the field, students will learn to approach population-level problems in medicine through the lens of "informatics", the science of information, with a focus on application over theory. Students will be required to use R (or another programming language) for data analysis assignments. Offered as SYBB 322 and SYBB 422. Prereq: SYBB 321.

SYBB 387. Undergraduate Research in Systems Biology. 1 - 3 Units.
This course provides students research experience in data science, proteomics, bioinformatics, and clinical informatics under the guidance of a faculty affiliated with the Systems Biology and Bioinformatics program. Areas of research include production of big data at bench (cellular proteomics, structural proteomics, genomics, and interaction proteomics) and analysis of big data such as computational/statistical biology, bioinformatics tool development and clinical research informatics. A written report must be approved by the sponsor and submitted to the director of the Center for Proteomics and Bioinformatics before credit is granted.

SYBB 388. Undergraduate Research. 1 - 3 Units.
Guided laboratory research under the sponsorship of a biology faculty member. May be carried out within the biology department or in associated departments. Appropriate forms must be secured in the biology department office. A written report must be approved by the biology sponsor and submitted to the chairman of the biology department before credit is granted. Only 3 credit-hours may count towards the biology majors or minor. Offered as BIOL 388 and SYBB 388.

SYBB 388S. Undergraduate Research - SAGES Capstone. 3 Units.
Guided laboratory research under the sponsorship of a biology faculty member. May be carried out within the biology department or in associated departments. May be taken only one semester during the student’s academic career. Appropriate forms must be secured in the biology department office. A written report must be approved by the biology sponsor and submitted to the chairman of the biology department before credit is granted. A public presentation is required. Offered as BIOL 388S and SYBB 388S. Counts as SAGES Senior Capstone.

SYBB 411A. Survey of Bioinformatics: Technologies in Bioinformatics. 1 Unit.
SYBB 311A/411A is a 5-week course that introduces students to the high-throughput technologies used to collect data for bioinformatics research in the fields of genomics, proteomics, and metabolomics. In particular, we will focus on mass spectrometer-based proteomics, DNA and RNA sequencing, genotyping, protein microarrays, and mass spectrometry-based metabolomics. This is a lecture-based course that relies heavily on out-of-class readings. Graduate students will be expected to write a report and give an oral presentation at the end of the course. SYBB 311A/411A is part of the SYBB survey series which is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming skills. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311A, BIOL 311A and SYBB 411A. Prereq: Graduate Standing or Requisites Not Met Permission.

SYBB 411B. Survey of Bioinformatics: Data Integration in Bioinformatics. 1 Unit.
SYBB 311B/411B is a five week course that surveys the conceptual models and tools used to analyze and interpret data collected by high-throughput technologies, providing an entry point for students new to the field of bioinformatics. The knowledge structures that we will cover include: biomedical ontologies, signaling pathways, and interaction networks. We will also cover tools for genome exploration and analysis. The SYBB survey series is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311A, BIOL 311B and SYBB 411B. Prereq: Graduate Standing or Requisites Not Met Permission.
SYBB 411C. Survey of Bioinformatics: Translational Bioinformatics. 1 Unit.
SYBB 311C/411C is a longitudinal course that introduces students to the latest applications of bioinformatics, with a focus on translational research. Topics include: ‘omic drug discovery, pharmacogenomics, microbiome analysis, and genomic medicine. The focus of this course is on illustrating how bioinformatic technologies can be paired with data integration tools for various applications in medicine. The course is organized as a weekly journal club, with instructors leading the discussion of recent literature in the field of bioinformatics. Students will be expected to complete readings beforehand; students will also work in teams to write weekly reports reviewing journal articles in the field. The SYBB survey series is composed of the following course sequence: (1) Technologies in Bioinformatics, (2) Data Integration in Bioinformatics, (3) Translational Bioinformatics, and (4) Programming for Bioinformatics. Each standalone section of this course series introduces students to an aspect of a bioinformatics project - from data collection (SYBB 311A/411A), to data integration (SYBB 311B/411B), to research applications (SYBB 311C/411C), with a fourth module (SYBB 311D/411D) introducing basic programming. Graduate students have the option of enrolling in all four courses or choosing the individual modules most relevant to their background and goals with the exception of SYBB 411D, which must be taken with SYBB 411A. Offered as SYBB 311C, BIOL 311C and SYBB 411C. Prereq: Graduate Standing or Requisites Not Met Permission.

SYBB 412. Survey of Bioinformatics: Programming for Bioinformatics. 3 Units.
SYBB 412 is a 3 credit-course that will introduce students to bioinformatics analysis and programming in the R language. This course is designed for those with little or no prior programming experience. However, advanced programmers can still learn bioinformatics pipelines and software packages to conduct research. Students will gain hands-on experience working with bioinformatics software, R packages and functions designed for bioinformatics applications. Programming for Bioinformatics course mainly focuses on R (project.org), and introduces students to basic programming in R, what packages are available, and teaches an introductory hands-on experience working with R by walking through the students in analyzing large -omics datasets. At the end of the class, the students are assessed with a small-scale project, where they analyze a publicly available dataset and produce a short report. Prereq: (Graduate Standing and SYBB 411A) or Requisites Not Met Permission.

SYBB 419. Applied Probability and Stochastic Processes for Biology. 3 Units.
Applications of probability and stochastic processes to biological systems. Mathematical topics will include: introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EEC 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419.

SYBB 421. Fundamentals of Clinical Information Systems. 3 Units.
Technology has played a significant role in the evolution of medical science and treatment. While we often think about progress in terms of the practical application of, say, imaging to the diagnosis and monitoring of disease, technology is increasingly expected to improve the organization and delivery of healthcare services, too. Information technology plays a key role in the transformation of administrative support systems (finance and administration), clinical information systems (information to support patient care), and decision support systems (managerial decision-making). This introductory graduate course provides the student with the opportunity to gain insight and situational experience with clinical information systems (CIS). Often considered synonymous with electronic medical records, the "art" of CIS more fundamentally examines the effective use of data and information technology to assist in the migration away from paper-based systems and improve organizational performance. In this course we examine clinical information systems in the context of (A) operational and strategic information needs, (B) information technology and analytic tools for workflow design, and (C) subsequent implementation of clinical information systems in patient care. Legal and ethical issues are explored. The student learns the process of "plan, design, implement" through hands-on applications to select CIS problems, while at the same time gaining insights and understanding of the impacts placed on patients and health care providers. Offered as EBME 473, IIME 473 and SYBB 421.

SYBB 422. Clinical Informatics at the Bedside and the Bench (Part II). 3 Units.
This course is part of a two semester series that provides student with an overview of the field of clinical informatics and its research applications. SYBB 422 focuses on the use of informatics in public health, epidemiology, and translational bioinformatics; topics include: pharmacosurveillance, comparative effectiveness research, and personalized medicine. Through lectures and in-depth readings of literature in the field, students will learn to approach population-level problems in medicine through the lens of "informatics", the science of information, with a focus on application over theory. Students will be required to use R (or another programming language) for data analysis assignments. Offered as SYBB 322 and SYBB 422. Prereq: SYBB 321.
SYBB 437. Laboratory Course in Proteomics. 3 Units.
SYBB 437 is designed to train students, postdoctoral fellows, and senior investigators in advanced methods in quantitative proteomics in the context of investigating the effects of pH on protein expression in the model organism E-coli. This intensive laboratory class is a 3-credit laboratory course and will be offered for a scheduled three hours time block once each week. In this course, we will cover topics in proteomics including protein sample preparation, total protein quantification, gel based separation and quantification methods, quantitative high throughput mass spectrometry and data analysis methods for examining these high throughput data. Students enrolled in SYBB 437 will be expected to turn in weekly lab reports summarizing their findings on each of the lab topics and will write two project reports at the end of labs 9 and 14 interpreting and summarizing the results obtained.

SYBB 459. Bioinformatics for Systems Biology. 3 Units.

SYBB 472. BioDesign. 3 Units.
Medical device innovations that would have been considered science fiction a decade ago are already producing new standards of patient care. Innovation leading to lower cost of care, minimally invasive procedures and shorter recovery times is equally important to the healthcare business leaders, educators, clinicians, and policy-makers. Innovation is a driver of regional economic development and wealth creation in organizational units ranging in size from the start-up to the Fortune 500 companies. In a broader context, the pace of translational research leading to product and service innovation is highly interdisciplinary; thus, new products and services result from team efforts, marked by a systematic, structured approach to bringing new medical technologies to market and impacting patient care. In this course we examine medical technology innovations in the context of (A) addressing unmet clinical needs, (B) the process of inventing new medical devices and instruments, and (C) subsequent implementation of these advances in patient care. In short, the student learns the process of "identify, invent, implement" in the field of BioDesign. Offered as EUME 472, IIME 472 and SYBB 472.

SYBB 501. Biomedical Informatics and Systems Biology Journal Club. 0 Unit.
The purpose of this journal club is to provide an opportunity for students to critically discuss a wide variety of informatics and systems biology topics and to present their works in progress. A wide range of informatics and systems theory approaches to conducting biomedical research will be accomplished through the guided selection of articles to be discussed during the club. Potential articles will be chosen from scientific journals including: Nature, Science, BMC Bioinformatics, BMC Systems Biology, the Journal of Bioinformatics and Computational Biology, and the Journal for Biomedical Informatics. During journal presentations, trainees will be expected to lead a discussion of the article that leads to the critical evaluation of the merit of the article and its implication for biomedical informatics and systems biology. The Journal Club will also provide a forum for trainees to present proposed, on-going, and completed research. Trainees will attend and participate in the Journal Club throughout their tenure in the program. The Journal Club will meet twice a month and each trainee will be required to present one journal article and one research in progress presentation yearly. The Journal Club will also include sessions where issues related to the responsible conduct of research are reviewed and extended.

SYBB 502. Clinical Informatics Journal Club. 0 Unit.
The Clinical Informatics Journal Club serves as a forum for students to present current research in the field of clinical informatics. Students are required to coregister for SYBB 421 or SYBB 422; weekly lectures in SYBB 421/422 will introduce topics for discussion in the journal club. Coreq: SYBB 421 or SYBB 422

SYBB 528. Contemporary Approaches to Drug Discovery. 3 Units.
This course is designed to teach the students how lead compounds are discovered, optimized, and processed through clinical trials for FDA approval. Topics will include: medicinal chemistry, parallel synthesis, drug delivery and devices, drug administration and pharmacokinetics, and clinical trials. A special emphasis will be placed on describing how structural biology is used for in silico screening and lead optimization. This component will include hands-on experience in using sophisticated drug discovery software to conduct in silico screening and the development of drug libraries. Each student will conduct a course project involving in silico screening and lead optimization against known drug targets, followed by the drafting of an inventory disclosure. Another important aspect of this course will be inclusion of guest lectures by industrial leaders who describe examples of success stories of drug development. Offered as BIOC 528, PHOL 528, PHRM 528, and SYBB 528.

SYBB 535. Independent Study in Biomedical Informatics. 1 - 3 Units.
For students pursuing MS or PhD degrees in SYBB, this course provides the opportunity for in-depth exposure to a subfield of systems biology and/or biomedical informatics. Degree-seeking students can enroll in this course prior to beginning 601 or 701 research. In conjunction with their proposed research advisor, enrolled students will undertake a self-directed study of a subfield of systems biology and/or biomedical informatics pertinent to their research area. The selected readings may also represent topics not covered by the student's coursework. The student's performance will be evaluated in an end-of-semester presentation or report at their advisor's discretion.
SYBB 555. Current Proteomics. 3 Units.
This course is designed for graduate students across the university who wish to acquire a better understanding of fundamental concepts of proteomics and hands-on experience with techniques used in current proteomics. Lectures will cover protein/peptide separation techniques, protein mass spectrometry, bioinformatics tools, and biological applications which include quantitative proteomics, protein modification proteomics, interaction proteomics, structural genomics and structural proteomics. Laboratory portion will involve practice on the separation of proteins by two-dimensional gel electrophoresis, molecular weight measurement of proteins by mass spectrometry, peptide structural characterization by tandem mass spectrometry and protein identification using computational tools. The instructors' research topics will also be discussed. Recommended preparation: CBIO 453 and CBIO 455. Offered as PHRM 555 and SYBB 555.

SYBB 600. Special Topics. 1 - 18 Units.
Offered as EECS 600 and SYBB 600.

SYBB 601. Systems Biology and Bioinformatics Research. 1 - 18 Units. (Credit as arranged.)

SYBB 651. Thesis M.S.. 1 - 18 Units. (Credit as arranged.)

SYBB 701. Dissertation Ph.D.. 1 - 9 Units. (Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Genetics and Genome Sciences

Biomedical Research Building
http://genetics.case.edu/
Phone: 216.368.3431
Anthony Wynshaw-Boris, MD, PhD, Chair
ajw168@case.edu

Clarice Young (clarice.young@case.edu), Coordinator

The Department of Genetics & Genome Sciences embraces a unified program devoted to outstanding research and teaching in all areas of genetics, with particular emphases on genomics, human genetics and animal models, development, and chromosome structure and function. Faculty conduct internationally recognized research programs in each of these areas. The also are committed to training the next generations of leading genetics researchers. The department has three special programs: the Center for Human Genetics, the Center for Computational Genomics, and the Genomic Medicine Institute (descriptions appear later in this narrative).

Programs offered lead to the PhD, combined MD/PhD degree, MS with a special emphasis in genetic counseling, or MS/MA dual degree in genetic counseling and bioethics. In addition to required and elective coursework, students participate in ongoing journal clubs, research seminars, and grand rounds. A program of departmental and interdepartmental seminars by outstanding visiting scientists provides regular exposure to a broad range of current research in genetics.

Applications to the PhD program in Genetics and Genome Sciences are through the Biomedical Sciences Training Program, which provides access to most of the biomedical science PhD programs at CWRU during the first semester. Students who wish to join Genetics and Genome Sciences directly should apply to the BSTP by selecting "Biomedical Sciences Training Program" as their Academic Program in the "Enrollment Information" section. Then, select Genetics and Genome Sciences as a Priority Program of Interest (PPI) in the Supplemental portion of the BSTP application form. Selecting the PPI option will identify you as a BSTP applicant who seeks admission only to the Genetics and Genome Sciences PhD program. Students interested in pursuing the combined MD/PhD program are admitted through the Medical Scientist Training Program (MSTP; please see separate listing in this publication). Those students interested in careers in genetic counseling apply directly to the Genetic Counseling Training Program, via the common Graduate Studies application (http://case.edu/gradstudies/prospective-students/admissions-information/graduate-program-applications).

The Center for Human Genetics is an integral part of the Department of Genetics and consists of both research and clinical laboratories involved in human and clinical genetics. This center supports research and clinical programs focusing on the molecular basis of inherited disease, human genetic disease mapping, and the genetic dissection of complex disease, as well as providing clinical care and training for postdoctoral fellows and genetic counseling students.

The Center for Computational Genomics is an interdisciplinary research and training program involving faculty in the Department of Population and Quantitative Health Sciences in the School of Medicine and in the Department of Electrical Engineering and Computer Science in the School of Engineering. The center provides opportunities to combine research in genetics, genomics, epidemiology, biostatistics, computer science, and systems biology.

The Genomic Medicine Institute is a joint program involving the Cleveland Clinic Foundation and Case. Its emphasis involves translating discoveries in basic and clinical research to clinical practice. The mission is to exploit the discoveries in genomics, epidemiology, ethics, pharmacology, genetics, and physiology to revolutionize the practice of medicine.

MS Genetic Counseling (plan B)
The Genetic Counseling Training Program is a 40 credit hour program that spans four academic semesters and an intervening summer. Acquisition and mastery of clinical competencies are reflected in the Program's didactic coursework, clinical rotations, research process and supplementary experiences. The sequence of medical genetics courses and genetic counseling courses are designed to introduce concepts regarding medical genetics, general medical practice, counseling theory and clinical skills such that they build from beginning skills to a more advanced skill set in the order needed for clinical experiences. The goal of the program is to provide students with the knowledge and clinical skills to function as competent and empathetic genetic counselors in a wide range of settings and roles. All of these activities enable successful graduates to meet the clinical competencies as outlined by the Accreditation Council for Genetic Counseling (ACGC) and successfully pass the American Board of Genetic Counseling certification examination (ABGC).

Experiential professional training occurs concurrently with formal coursework and over the summer between years one and two. Clinical settings include a variety of clinics and inpatient services at the Center for Human Genetics at University Hospitals Cleveland Medical Center, the Genomic Medicine Institute at the Cleveland Clinic, Genetic Services at MetroHealth Medical Center and Medical Genetics at Akron Children's Hospital. Students also rotate through the Center for Human Genetics Diagnostic Laboratory which includes experiences in cytogentics, molecular genetics, cancer cytogenetics and maternal serum screening. Student participation in these and other departmental professional
and educational activities such as lectures, seminars, journal club, grand rounds, genetics conferences, and various research, counseling and patient management conferences is expected throughout the program. Coursework and clinical experiences are designed to develop the competencies expected by the ACGC.

The First Year

The major activities during the first year consist of course work (in plan of study below), clinical observations and defining a research question and preparing a research proposal. Observational clinical rotations begin early in October with students observing in prenatal genetics, cancer genetics, and general genetics clinics at the program's three affiliated institutions. Additionally, students meet several times over the fall semester to discuss the research process, potential topics, development of a research question and are introduced to the faculty's research areas of interest.

In addition to continuing clinical observational rotations and research, students continue with course work including an introduction to research methods and more in-depth theory and practice in the psychosocial aspects of counseling during spring semester.

During the intervening summer of years 1 and 2, students begin clinical rotations at the Medical Genetics Division at Akron Children's Hospital to gain exposure in various clinical settings including prenatal, general genetics, pediatrics, specialty clinics and cancer genetics clinic. They also rotate through the Center for Human Genetics Laboratory to become familiarized with the clinical aspects of a diagnostic cytogenetics and molecular genetics laboratory.

The Second Year

The major focus of the second year is continued clinical experiences, research and taking the comprehensive written and oral examinations. Students also complete their coursework, taking one course each semester.

At the beginning of spring semester in January, the students sit for the written comprehensive examination (covering the didactic and clinical genetic counseling material covered to date in the program) and the oral section of the examination, which is given shortly after the written portion. Both examinations are intended to allow students to expand on their knowledge base of human and medical genetics and genetic counseling. Students are expected to pass both sections of the examination in order to meet graduation requirements by the Program. The written portion of the examination is patterned after the national certification examination given by the American Board of Genetic Counseling.

Students continue to work on data collection and analyses for their research projects, which should result in a publishable document. They meet with the Program Director periodically to review their progress as well as with their research committee and of course, are meeting with their mentor on a more frequent basis. During the fall semester of the second year, the students also attend the National Society of Genetic Counselors annual education meeting. This provides an opportunity for students to meet genetic counselors from across the country, to attend scientific sessions to continue adding to their knowledge base and to meet and discuss job opportunities with prospective employers. Successful completion of the program fulfills the curricular and clinical training requirements for eligibility to sit for the certification examination given by the ABGC.

The sequence of courses for students is as follows:

**MS Plan of Study**

<table>
<thead>
<tr>
<th>Year</th>
<th>Course</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
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<tbody>
<tr>
<td><strong>First Year</strong></td>
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<td></td>
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<tr>
<td></td>
<td>Intensive: Medical Terminology (1 week)</td>
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<tr>
<td></td>
<td>Embryology (online course)</td>
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<tr>
<td></td>
<td>Advanced Medical Genetics: Molecular &amp; Cytogenetics (GENE 524)</td>
<td>2</td>
<td></td>
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<td></td>
<td>Principles and Practices of Genetic Counseling (GENE 528)</td>
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<tr>
<td></td>
<td>Advanced Medical Genetics: Quantitative Genetics &amp; Genomics (GENE 526)</td>
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<td></td>
<td>or Advanced Medical Genetics: Biochemical Genetics (GENE 527)</td>
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<td></td>
<td>Direct Practice Generalist Methods &amp; Skills (SASS 477)</td>
<td>3</td>
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<td></td>
<td>Intensive: Human Development (1 week)</td>
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<td>Psychosocial Issues in Genetic Counseling (GENE 529)</td>
<td>3</td>
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<td></td>
<td>Advanced Medical Genetics: Clinical Genetics (GENE 525)</td>
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<td></td>
<td>Cancer Genetics (GENE 531)</td>
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<td>Research in Genetics (GENE 601)</td>
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<td>Clinical Practicum in Genetic Counseling (GENE 532)</td>
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<td></td>
<td>Advanced Medical Genetics: Biochemical Genetics (GENE 527)</td>
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<td></td>
<td>or Advanced Medical Genetics: Quantitative Genetics &amp; Genomics (GENE 526)</td>
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<td></td>
<td>Clinical Practicum in Genetic Counseling (GENE 532)</td>
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<td></td>
<td>Research in Genetics (GENE 601)</td>
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<td></td>
<td>Ethical Issues in Genetics/Genomics (BETH 412)</td>
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<td></td>
<td>Clinical Practicum in Genetic Counseling (GENE 532)</td>
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<td></td>
<td>Research in Genetics (GENE 601)</td>
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<td>Year Total:</td>
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<td></td>
<td>Total Units in Sequence:</td>
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**MS/MA in Genetic Counseling and Bioethics (plan B)**

The Departments of Genetics & Genome Sciences and Bioethics offer a dual degree program between the Masters in Genetic Counseling and
the Masters in Bioethics Programs. The dual degree program provides a comprehensive curriculum integrating foundational principles of genetics and ethics. The goal of the program is to train Genetic Counselors who wish to apply additional Bioethics expertise into their clinical practice and/or research.

The dual degree program allows graduates to engage in both contemplative analysis and application of knowledge in the counseling of patients and should allow graduates to be more prepared to participate in the ongoing national dialogue about the ethical, legal, and social implications of advances in genomic technology as well as research within their home institutions and with other counselors nationwide regarding issues of new genomic testing technology, concerns about genetic services, and issues related to genetic discrimination, privacy, and the return of genetic and genomic results.

The curriculum for the Dual Genetic Counseling/Bioethics Degree consists of 59 credit hours to be completed in 2.5 years. Students enrolled in the dual degree program will spend their first year taking courses entirely within the Genetic Counseling Program and then will spread out their Bioethics coursework over the next 1.5 years while continuing with required coursework and clinical rotations in the genetic counseling program.

In addition to both a written and oral comprehensive examination as part of the Genetic Counseling Training Program, the dual degree requires a research project be carried out for the completion of the both degrees. For the dual degree, students will be required to choose a research project that includes ethical, legal, or social issues of genetic counseling practice, clinical genetics or genomics, or genetic research. Students will also be required to include at least one Bioethics Faculty member on their Research Project Committee.

Students who would like to enroll in the dual degree program will apply and be admitted into each program separately. While admissions committees for each program will communicate with each other regarding applicants, each admissions committee will decide independently about the suitability of the applicant to their program.

Once students have been admitted, the Director of the Genetic Counseling Training Program and the Director of the MA Program in Bioethics will act as student advisors for each of the two programs individually as well as collaboratively - meeting monthly to assess student progress, address any student or faculty concerns, and assure that student progress in each of the programs, and their overlapping components, are being achieved.

**MS/MA Plan of Study**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Fall</th>
<th>Units</th>
<th>Spring</th>
<th>Summer</th>
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<tbody>
<tr>
<td>Advanced Medical Genetics: Molecular &amp; Cytogenetics (GENE 524)</td>
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<tr>
<td>Advanced Medical Genetics: Quantitative Genetics &amp; Genomics (GENE 526)</td>
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<tr>
<td>Principles and Practices of Genetic Counseling (GENE 528)</td>
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<td>Direct Practice Generalist Methods &amp; Skills (SASS 477)</td>
<td>3</td>
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<tr>
<td>Psychosocial Issues in Genetic Counseling (GENE 529)</td>
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<td><strong>Year Total:</strong></td>
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<thead>
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<th>Fall</th>
<th>Units</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Practicum in Genetic Counseling (GENE 532)</td>
<td>4</td>
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<tr>
<td>Advanced Medical Genetics: Biochemical Genetics (GENE 527)</td>
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<tr>
<td>Foundations in Bioethics I (BETH 401)</td>
<td>6</td>
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<tr>
<td>Clinical Practicum in Genetic Counseling (GENE 532)</td>
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<tr>
<td>Ethical Issues in Genetics/Genomics (BETH 412)</td>
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<tr>
<td>Foundations in Bioethics II (BETH 402)</td>
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<tr>
<td>Research in Genetics (GENE 601)</td>
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<th>Third Year</th>
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<th>Fall</th>
<th>Units</th>
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<td>Research in Genetics (GENE 601)</td>
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<tr>
<td>Clinical Ethics Rotation (BETH 405)</td>
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<tr>
<td>BETH Elective</td>
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**Total Units in Sequence:** 59

**PhD Genetics**

Admissions to the Genetics program may be obtained through the integrated Biomedical Sciences Training Program, by direct admission to the department or via the MSTP program. The following summary pertains to most incoming PhD students, regardless of the route through which they enter the program. Exceptions are occasionally made to reflect previous educational experiences (e.g., a prior MS degree).

**The First Year**

Course work, rotations in at least three laboratories, and participation in seminars, journal clubs, and research meetings are the major activities of first year students. During the Fall term, most students take core courses in Cell and Molecular Biology (CBIO 453 Cell Biology I/CBIO 455 Molecular Biology I) that are offered for Biomedical Sciences Training Program departments. Laboratory rotations begin in early July and the choice of a thesis advisor is usually made at the end of December (see below for more details on Choosing an Advisor).

During the Spring term, PhD students take the core Advanced Eukaryotic Genetics course sequence (GENE 500 Advanced Eukaryotic Genetics I/GENE 504 Advanced Eukaryotic Genetics II), which is followed by a written comprehensive examination in late May or early June. This core course is designed to acquaint students with fundamental principles and methodologies used in modern genetic research. The focus is on similarities and differences between different model organisms used in
genetics research. Also during the Spring term and continuing into the Summer, students begin formulating a doctoral research proposal.

**The Second Year and Beyond**

During the second year, students participate in a Proposal Writing Workshop (GENE 511 Grant Writing and Reviewing Skills Workshop) and take other advanced elective courses based on the academic background and interest of the student. The remaining elective credits can be satisfied by choosing from the courses offered by departmental faculty or participating training faculty from other departments (see List of Courses below). At the end of the second academic year, students must pass an oral proposal defense in order to advance to candidacy for the PhD degree. An outline of the typical course of study is shown below.

**PhD Genetics, Plan of Study Sample**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Biology I (CBIO 453/455)</td>
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<td></td>
</tr>
<tr>
<td>Molecular Biology I (CBIO 455)</td>
<td>4</td>
<td></td>
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<tr>
<td>Complete 3 lab rotations (July 1 to Dec 15)</td>
<td></td>
<td></td>
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<tr>
<td>Choose Ph.D. mentor (end December)</td>
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<td></td>
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<tr>
<td>Research in Genetics (GENE 601)</td>
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<tr>
<td>Advanced Eukaryotic Genetics I (GENE 500/504)</td>
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<tr>
<td>Ph.D. Comprehensive exam (end of May or early June)</td>
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<tr>
<td>Advanced Eukaryotic Genetics II (GENE 504)</td>
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<tr>
<td>Research in Genetics (GENE 601)</td>
<td>3</td>
<td></td>
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<tr>
<td>Program Directors meet with students to discuss status, mentor; students begin assembling PhD thesis committee</td>
<td>0</td>
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<tr>
<td>Year Total:</td>
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<table>
<thead>
<tr>
<th>Second Year</th>
<th>Units</th>
<th>Spring</th>
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<tr>
<td>Grant Writing and Reviewing Skills Workshop (GENE 511)</td>
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<tr>
<td>Elective course (Genetics or other)</td>
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<tr>
<td>Research in Genetics (GENE 601)</td>
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</tr>
<tr>
<td>Elective course (Genetics or other)</td>
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<tr>
<td>Research in Genetics (GENE 601)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Oral Defense of Thesis Proposal (to be completed by June 1)</td>
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<tr>
<td>Year Total:</td>
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<thead>
<tr>
<th>Third Year</th>
<th>Units</th>
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<tbody>
<tr>
<td>Elective</td>
<td></td>
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<tr>
<td>Either semester 1 elective course (Genetics or other)</td>
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<tr>
<td>Dissertation Ph.D. (GENE 701)</td>
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<tr>
<td>Dissertation Ph.D. (GENE 701)</td>
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<td>Year Total:</td>
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**Fourth Year**

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<tr>
<th>Year Total:</th>
<th>Units</th>
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<tr>
<td>Year Total:</td>
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</table>

Total Units in Sequence: 72

Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045).

**Other Requirements**

- Students meet twice per year with Thesis Committee
- Students meet once per year with Genetics Graduate Education Committee
- Genetics Student Seminar (weekly attendance, yearly presentation)
- Genetics Journal Club (weekly attendance, yearly presentation in spring semester)
- Genetics Retreat (yearly participation, organized by students)
- Two first-author, peer-reviewed publications

**Courses**

**BETH 412. Ethical Issues in Genetics/Genomics. 3 Units.**

This course is designed to familiarize graduate students with the major controversies over the generation and use of new human genetic information. Topics will include the spread of predictive genetic testing, prenatal diagnosis, genetic discrimination, human genetic variation research, eugenics, genetic counseling, and the limits of human gene therapy. The course will be conducted as a seminar, involving discussions of readings, guest speakers, and student presentations.

**GENE 367. Commercialization and Intellectual Property Management. 3 Units.**

This interdisciplinary course covers a variety of topics, including principles of intellectual property and intellectual property management, business strategies and modeling relevant to the creation of start-up companies and exploitation of IP rights as they relate to biomedical-related inventions. The goal of this course is to address issues relating to the commercialization of biomedical-related inventions by exposing law students, MBA students, and Ph.D. candidates (in genetics and proteomics) to the challenges and opportunities encountered when attempting to develop biomedical intellectual property from the point of early discovery to the clinic and market. Specifically, this course seeks to provide students with the ability to value a given technological advance or invention holistically, focusing on issues that extend beyond scientific efficacy and include patient and practitioner value propositions, legal and intellectual property protection, business modeling, potential market impacts, market competition, and ethical, social, and healthcare practitioner acceptance. During this course, law students, MBA students, and Ph.D. candidates in genomics and proteomics will work in teams of five (two laws students, two MBA students and one Ph.D. candidate), focusing on issues of commercialization and IP management of biomedical-related inventions. The instructors will be drawn from the law school, business school, and technology-transfer office. Please visit the following website for more information: fusioninnovate.com. Offered as LAWS 5341, MGMT 467, GENE 367, GENE 467, EBME 467 and EECS 467.
GENE 451. A Data-Driven Introduction to Genomics and Human Health. 3 Units.
This course introduces the foundational concepts of genomics and genetic epidemiology through four key principles: 1) Teaching students how to query relational databases using Structure Query Language (SQL); 2) Exposing students to the most current data used in genomics and bioinformatics research, providing a quantitative understanding of biological concepts; 3) Integrating newly learned concepts with prior ones to discover new relationships among biological concepts; and 4) providing historical context to how and why data were generated and stored in the way they were, and how this gave rise to modern concepts in genomics. Offered as PQHS 451, GENE 451, and MPH 451.

GENE 467. Commercialization and Intellectual Property Management. 3 Units.
This interdisciplinary course covers a variety of topics, including principles of intellectual property and intellectual property management, business strategies and modeling relevant to the creation of start-up companies and exploitation of IP rights as they relate to biomedical-related inventions. The goal of this course is to address issues relating to the commercialization of biomedical-related inventions by exposing law students, MBA students, and Ph.D. candidates (in genetics and proteomics) to the challenges and opportunities encountered when attempting to develop biomedical intellectual property from the point of early discovery to the clinic and market. Specifically, this course seeks to provide students with the ability to value a given technological advance or invention holistically, focusing on issues that extend beyond scientific efficacy and include patient and practitioner value propositions, legal and intellectual property protection, business modeling, potential market impacts, market competition, and ethical, social, and healthcare practitioner acceptance. During this course, law students, MBA students, and Ph.D. candidates in genomics and proteomics will work in teams of five (two laws students, two MBA students and one Ph.D. candidate), focusing on issues of commercialization and IP management of biomedical-related inventions. The instructors will be drawn from the law school, business school, and technology-transfer office. Please visit the following website for more information: fusioninnovate.com. Offered as LAWS 5341, MGMT 467, GENE 467, EBME 467 and EECS 467.

GENE 488. Yeast Genetics and Cell Biology. 3 Units.
This seminar course provides an introduction to the genetics and molecular biology of the yeasts S. cerevisiae and S. pombe by a discussion of current literature focusing primarily on topics in yeast cell biology. Students are first introduced to the tools of molecular genetics and special features of yeasts that make them important model eukaryotic organisms. Some selected topics include: 1) genome organization and function, 2) genetic strategies for dissecting complex pathways in organisms ranging from Drosophila to C. elegans to mouse and human. Recommended preparation: GENE 500 or permission of instructor.

GENE 504. Advanced Eukaryotic Genetics II. 3 Units.
Fundamental principles of modern genetics: population and quantitative genetics, dissection of genome organization and function, transgenics, developmental genetics, genetic strategies for dissecting complex pathways in organisms ranging from Drosophila and C. elegans to mouse and human. Recommended preparation: GENE 500 or permission of instructor.

GENE 505. Genetics Journal Club. 1 Unit.
Genetics Journal Club is a graduate level course designed to facilitate discussion of topics in Genetics. Students choose “hot” papers in Genetics and present them to their peers. Group presentations are designed to encourage audience participation. The intent of this class is to expose students to cutting edge topics in Genetics and to instill teaching and leadership skills.

GENE 511. Grant Writing and Reviewing Skills Workshop. 3 Units.
This is an introductory graduate course in grant writing and reviewing skills. During this course each student will write a research grant on a topic of his or her choice. Proposals may form the basis for the written component of the preliminary examination in the Genetics Department. Students will also participate in editing and reviewing the proposals of their classmates. Prereq: GENE 500 and GENE 504 or consent of instructor.

GENE 513. Stem Cell Genetics. 3 Units.
This course focuses on fundamental aspects of development with implications for stem cell therapy, tissue engineering, regenerative medicine and postnatal health. The goal of the class is to inform and promote critical thinking and discussion of research topics of medical importance in developmental biology. The themes of the course will include the conditions and factors which promote pluripotency and differentiation, regeneration and repair, epigenetic stability and reprogramming, and prenatal conditions which affect postnatal health. The topics will include early embryonic development and embryonic stem cells, cardiac development and regeneration, bone development and repair, pancreatic development and regeneration, germ line stem cells and conditions affecting postnatal health. The course will be structured around facilitated discussion of the primary literature.

GENE 524. Advanced Medical Genetics: Molecular & Cytogenetics. 2 - 3 Units.
This course provides an in-depth forum for discussion of fundamental principles regarding clinical cytogenetics and molecular genetics and their relevance to medical genetics, genomics and genetic counseling. Following a historical overview, topics include a discussion of numerical and structural aberrations, sex chromosome abnormalities, issues regarding population cytogenetics, clinical relevance of such findings as marker chromosomes, mosaicism, contiguous gene deletions and uniparental disomy. The course will cover principles of molecular genetics including structure, function and regulations of genes (DNA, RNA, proteins), genetic variation, inheritance patterns and both cytogenetic and molecular laboratory techniques (fluorescence in situ hybridization, micro-array, SNP analyses, sequencing) in the clinical laboratory. Students who register for 3.00 credit hours are required to do an additional paper.

GENE 525. Advanced Medical Genetics: Clinical Genetics. 2 - 3 Units.
Fundamental principles regarding congenital malformations, dysmorphology and syndromes. Discussion of a number of genetic disorders from a systems approach: CNS malformations, neurodegenerative disorders, craniofacial disorders, skeletal dysplasias, connective tissue disorders, hereditary cancer syndromes, etc. Discussions also include diagnosis, etiology, genetics, prognosis and management.
GENE 526. Advanced Medical Genetics: Quantitative Genetics & Genomics. 2 - 3 Units.
The purpose of this course is twofold: first, to provide a foundation in quantitative genetics and second, to focus on genomic approaches and technologies which have greatly expanded our understanding of not only rare genetic disorders but common ones as well. We will cover concepts related to risk assessment and calculation and its application to medical genetics including principles and application of Hardy Weinberg equilibrium as well as applying Bayes’ Theorem as a mechanism to refine risk assessment based on data specific to a patient. We will also focus on understanding the clinical implications of the interpretation of next generation sequencing results, identify limitations of genomic technologies, and practice curation / annotation and interpretation of genomic testing results. In addition, we will discuss resources and bioinformatics tools including national databases and clinical labs to aid in the interpretation of genomic test results including variants of uncertain significance. Students who register for 3.00 credit hours are required to do an additional paper.

GENE 527. Advanced Medical Genetics: Biochemical Genetics. 2 - 3 Units.
Fundamental principles of metabolic testing; amino acid disorders; organic acid disorders; carbohydrate disorders; peroxisomal disorders; mitochondrial disorders; etc. Discussion of screening principles and newborn screening as well as approaches to diagnosis, management and therapy for metabolic diseases.

GENE 528. Principles and Practices of Genetic Counseling. 3 Units.
Fundamental principles needed for the practicing genetic counselor. Topics include skills in obtaining histories (prenatal, perinatal, medical, developmental, psychosocial and family); pedigree construction and analysis, physical growth and development; the genetic evaluation; the physical examination and laboratory analyses; prenatal issues, prenatal screening and diagnosis; and teratogenicity.

GENE 529. Psychosocial Issues in Genetic Counseling. 3 Units.
Fundamental principles regarding the psychosocial aspects of genetic disease and birth defects, its psychological and social impact on the individual and family. Topics include the genetic counseling interview process, issues regarding pregnancy and prenatal diagnosis, chronicity, death and loss. Cultural issues and their impact on the genetic counseling session are addressed. Resources for families are also explored. Basic interviewing skills are presented. Students will have an opportunity for practice of skills through role play and actual interviewing situations.

GENE 530. Cancer Genetics. 2 - 3 Units.
This seminar will discuss basic concepts in cancer epidemiology, principles of cancer genetics, inherited cancer syndromes, cytogenetics of cancers, prediagnosis analysis for familial cancer risk and approaches to the differential diagnosis of inherited and familial cancers. Additionally, topics of risk assessment, genetic testing, screening, management and psychosocial issues in providing genetic counseling to patients with familial and inherited cancers will be discussed.

GENE 531. Cancer Genetics. 2 - 3 Units.
This seminar will discuss basic concepts in cancer epidemiology, principles of cancer genetics, inherited cancer syndromes, cytogenetics of cancers, prediagnosis analysis for familial cancer risk and approaches to the differential diagnosis of inherited and familial cancers. Additionally, topics of risk assessment, genetic testing, screening, management and psychosocial issues in providing genetic counseling to patients with familial and inherited cancers will be discussed.

GENE 532. Clinical Practicum in Genetic Counseling. 1 - 6 Units.
This clinical practicum provides the student an opportunity to function as a genetic counselor by preparing for cases; obtaining appropriate histories; determining risks; performing psychosocial assessments; discussing disease characteristics, inheritance, and natural history; providing anticipatory guidance and supportive counseling; using medical and community resources; and follow-up. Students rotate through four clinical areas and one laboratory and will register for a total of 12 hours over the course of the program. Recommended preparation: Admission to Genetic Counseling Training Program.

GENE 536. Advanced Medical Genetics. 2 - 3 Units.
This course provides an introduction to various types of light microscopy, digital and video imaging techniques, and their applications to biological and biomedical sciences via lectures and hands-on experience. Topics covered include geometrical and physical optics; brightfield, darkfield, phase contrast, DIC, fluorescence and confocal microscopes; and digital image processing. Offered as GENE 537, MBIO 537, and PHOL 537.

GENE 601. Research in Genetics. 1 - 9 Units.
(Credit as arranged.)

GENE 5651. Thesis M.S.. 1 - 9 Units.
(Credit as arranged.) Master’s Thesis Plan A.

GENE 701. Dissertation Ph.D.. 1 - 9 Units.
(Credit as arranged.) Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Molecular Biology and Microbiology
Room W200, School of Medicine
http://www.case.edu/med/microbio/index.htm
Phone: 216.368.3420
Jonathan Karn, PhD, Reinberger Professor, Chair
jonathan.karn@case.edu
Brinn Omabegho (brinn.omabegho@case.edu), Manager

The Department of Molecular Biology and Microbiology provides a focus within the School of Medicine for the study of the growth and development of microorganisms at the molecular level. The Department is home to three PhD programs: Cell Biology, Molecular Biology and Microbiology, and Molecular Virology.

Faculty have nationally-funded research programs. Many faculty serve on study sections of national agencies, publish in the most prestigious journals, serve as editors of journals, and take leadership positions in throughout Case School of Medicine. The department also enjoys numerous collaborations with faculty in the Departments of Biochemistry, Neuroscience, and Genetics, the Case Comprehensive Cancer Center, the Visual Sciences Research Center, the Center for AIDS Research, and the Center for RNA Molecular Biology, and the Department of Cell Biology at the Lerner Research Center at CCF, because of shared research interests. All these activities create a vibrant scientific environment.

Research areas include the study of normal cell functions, microbial systems, viruses, and infectious diseases. It is only by developing a thorough understanding of the fundamental biology of cells and pathogenic microbes, their host organisms, and how the two interact during infection that improved strategies for prevention and treatment of infectious diseases can be achieved.

PhD in Cell Biology, Molecular Biology and Microbiology, Molecular Virology
The Department of Molecular Biology and Microbiology is home to three PhD programs: Cell Biology, Molecular Biology and Microbiology, and Molecular Virology. Admissions for all three of these programs occurs through the common PhD admissions program, the Biomedical Sciences Training Program (p. 730). In addition, students in the Medical Scientist Training Program (p. 725) (MSTP) can also pursue these three PhD programs.
PhD Requirements
Students entering through BSTP begin the first of three research rotations during the summer and participate in the Core Curriculum in Cell and Molecular Biology (C3MB), two integrated courses which provide formal instruction in modern cell and molecular biology. Some exceptional students with strong backgrounds, such as a previous Master’s Degree, may be eligible to be exempted from part of the Core Curriculum, and instead enroll in one or more advanced courses during the fall semester. Some students may be eligible to apply for the transfer of credit from their previous institution (please visit here (http://gradstudies.case.edu) for more information). Transfer credit must be requested prior to beginning coursework at CWRU.

A student who chooses a thesis advisor from Cell Biology, Molecular Biology and Microbiology or Molecular Virology can become a member of one of these three PhD programs. To earn a PhD a student must complete 400-level graduate Core and Elective coursework including Responsible Conduct of Research and Research Rigor and Reproducibility as described in the course of study.

Students in each program are expected to attend the joint student seminars (MBIO 435 Seminar in Molecular Biology/Microbiology/MVIR 435 Seminar in Molecular Biology/Microbiology/CLBY 435 Seminar in Molecular Biology/Microbiology) for at least 3 semesters (3 credit hours). Continued participation in the seminars after completion of this requirement is encouraged. Up to 4 credit hours can be allocated to the seminar course (one credit per semester).

Molecular Biology and Microbiology/Molecular Virology and Cell Biology students should take the MBIO 450 Cells and Pathogens/MVIR 450 Cells and Pathogens/CLBY 450 Cells and Pathogens.

In addition, Cell Biology Students must take both of the following fundamental course: CLBY 526 Cell Biology and Human Disease/MBIO 526 Cell Biology and Human Disease and CLBY 488 Yeast Genetics and Cell Biology. Molecular Virology Students must take MVIR 445 Molecular Biology and Pathogenesis of RNA and DNA Viruses.

Beyond that, any combination of graduate courses from within or outside the department can be used to fulfill the requirement as long as the planned program of study has the approval of the student's advisor and committee.

In addition, each PhD student must successfully complete a qualifier examination for advancement to candidacy in the form of a short grant proposal with oral defense. The qualifier is generally completed in the summer after year two. During the dissertation period, students are expected to meet twice a year with the thesis committee, present seminars in the department, and fulfill journal publication requirements. Throughout the doctoral training, students are expected to be enthusiastic participants in seminars, journal clubs, and research meetings in the lab and program.

Plan of Study
Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045).

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
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<tr>
<td>Cell Biology I (CBIO 453)</td>
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<td>Molecular Biology I (CBIO 455)</td>
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Seminar in Molecular Biology/Microbiology (MBIO 435) (optional)
or Seminar in Molecular Biology/Microbiology (CLBY 435)
or Seminar in Molecular Biology/Microbiology (MVIR 435)
Research Rotation in Biomedical Sciences Training Program (BSTP 400) or Research Rotation in Medical Scientist Training Program (MSTP 400)

| Year Total: | 7-16 | 5-14 | 1 |

Second Year

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<tr>
<th>Units</th>
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<td>Seminar in Molecular Biology/Microbiology (MBIO 435)</td>
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<td>or Seminar in Molecular Biology/Microbiology (CLBY 435)</td>
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<td>or Seminar in Molecular Biology/Microbiology (MVIR 435)</td>
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<td>Elective graduate coursework</td>
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<tr>
<td>Research in Molecular Biology and Microbiology (MBIO 601)</td>
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<td>or Special Problems (CLBY 601)</td>
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<td>or Research (MVIR 601)</td>
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<tr>
<td>On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)</td>
<td>1</td>
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<tr>
<td>Year Total:</td>
<td>5-14</td>
<td>5-14</td>
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</tbody>
</table>

Total Units in Sequence: 23-59

Third Year: Either semester, complete elective coursework so that total graded courses = 24 credits; Research credits switch from 601 to 701 once passed into candidacy.
Third Year + Full-time thesis research (701) - 18 total credit hours total

CLBY Courses

CLBY 416. Fundamental Immunology. 4 Units.
Introductory immunology providing an overview of the immune system, including activation, effector mechanisms, and regulation. Topics include antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity, innate versus adaptive immunity, cytokines, and basic molecular biology and signal transduction in B and T lymphocytes, and immunopathology. Three weekly lectures emphasize experimental findings leading to the concepts of modern immunology. An additional recitation hour is required to integrate the core material with experimental data and known immune mediated diseases. Five mandatory 90 minute group problem sets per semester will be administered outside of lecture and recitation meeting times. Graduate students will be graded separately from undergraduates, and 22 percent of the grade will be based on a critical analysis of a recently published, landmark scientific article. Offered as BIOL 316, BIOL 416, CLBY 416, PATH 316 and PATH 416. Prereq: Graduate standing.

CLBY 417. Cytokines: Function, Structure, and Signaling. 3 Units.
Regulation of immune responses and differentiation of leukocytes is modulated by proteins (cytokines) secreted and/or expressed by both immune and non-immune cells. Course examines the function, expression, gene organization, structure, receptors, and intracellular signaling of cytokines. Topic include regulatory and inflammatory cytokines, colony stimulating factors, chemokines, cytokine and cytokine receptor gene families, intracellular signaling through STAT proteins and tyrosine phosphorylation, clinical potential, and genetic defects. Lecture format using texts, scientific reviews and research articles. Recommended preparation: PATH 416 or equivalent. Offered as BIOL 417, CLBY 417, and PATH 417.

CLBY 435. Seminar in Molecular Biology/Microbiology. 1 Unit.
Graduate students will attend the departmental seminar given by all graduate students in the Department of Molecular Biology and Microbiology, in the Molecular Virology Program, and in the Cell Biology Program, as well as give a seminar on their own thesis research. Students will be evaluated by the faculty member in charge of that student’s seminar with input from the students’ own thesis committee. After each seminar, the student presenter will meet with other graduate students for peer review of the content, delivery, and style of the seminar. Peer reviewers will also be evaluated for the quality of their input. Offered as CLBY 435 and MBIO 435 and MVIR 435.

CLBY 450. Cells and Pathogens. 3 Units.
Modern molecular cell biology owes a great debt to viral and bacterial pathogens as model systems. In some instances pathogens operate by faithful mimicry of host proteins, and other cases represent the result of extensive molecular tinkering and convergent evolution. This course will also explore numerous mechanisms utilized by pathogens to subvert the host and enhance their own survival. Topics covered include nuclear regulatory mechanisms, protein synthesis and stability, membrane-bound organelles, endocytosis and phagocytosis, and factors that influence cell behavior such as cytoskeleton rearrangements, cell-cell interactions, and cell migration. Additional topics include cell signaling and co-evolution of pathogens and host cell functions. Students are expected to come to class prepared to discuss pre-assigned readings consisting of brief reviews and seminal papers from the literature. Student assessment will be based on effective class participation (approximately 80%) and successful presentation of an independent research topic (approximately 20%). Offered as CLBY 450, MBIO 450, and MVIR 450. Prereq: CBIO 453 and CBIO 455 or permission of instructor.

CLBY 466. Cell Signaling. 3 Units.
This is an advanced lecture/journal/discussion format course that covers cell signaling mechanisms. Included are discussions of neurotransmitter-gated ion channels, growth factor receptor kinases, cytokine receptors, G protein-coupled receptors, steroid receptors, heterotrimeric G proteins, ras family GTPases, second messenger cascades, protein kinase cascades, second messenger regulation of transcription factors, microtubule-based motility, actin/myosin-based motility, signals for regulation of cell cycle, signals for regulation of apoptosis. Offered as CLBY 466, PHOL 466 and PHRM 466.

CLBY 468. Membrane Physiology. 3 Units.
This student-guided discussion/journal course focuses on biological membranes. Topics discussed include thermodynamics and kinetics of membrane transport, oxidative phosphorylation and bioenergetics, electrophysiology of excitable membranes, and whole and single channel electrophysiology, homeostasis and pH regulation, volume and calcium regulation. Offered as CLBY 468 and PHOL 468.

CLBY 488. Yeast Genetics and Cell Biology. 3 Units.
This seminar course provides an introduction to the genetics and molecular biology of the yeasts S. cerevisiae and S. pombe by a discussion of current literature focusing primarily on topics in yeast cell biology. Students are first introduced to the tools of molecular genetics and special features of yeasts that make them important model eukaryotic organisms. Some selected topics include cell polarity, cell cycle, secretory pathways, vesicular and nuclear/cytoplasmic transport, mitochondrial import and biogenesis, chromosome segregation, cytoskeleton, mating response and signal transduction. Offered as CLBY 488, GENE 488, MBIO 488, and PATH 488.

CLBY 511. Cell Biology Seminar. 1 Unit.
The Cell Biology Seminar provides a forum for presentation and discussion of contemporary issues in Cell Biology. Students, fellows, local faculty and guest speakers present both research talks and journal clubs.

CLBY 512. Cell Biology Seminar. 1 Unit.
The Cell Biology Seminar provides a forum for presentation and discussion of contemporary issues in Cell Biology. Students, fellows, local faculty and guest speakers present both research talks and journal clubs.

CLBY 519. Molecular Biology of RNA. 3 Units.
Selected topics regarding editing, enzymatic function, splicing, and structure of RNA. Offered as BIOLC 519, CLBY 519, and MBIO 519.

CLBY 525. Protein Misfolding and Human Disease: Molecular Basis and Clinical Implications. 3 Units.
This is a graduate-level seminar course that familiarizes the students with human diseases resulting from aberrations in protein folding, processing, and turnover. Contribution of associated inflammation and heavy metal mis-metabolism will be discussed where appropriate. Specific examples include, but are not limited to, Alzheimer’s Disease, Parkinson’s Disease, Prion disorders multiple sclerosis, amyotrophic lateral sclerosis, Huntington’s Disease, and others based on popular demand. The students will be expected to discuss relevant research publications in an interactive format. Grading will be based on class participation and an R21 grant proposal on the subject of their choice that does not overlap with their current area of research. Recommended Preparation: Concurrent enrollment in PATH 526, on grant-writing skills, is highly recommended but not required. Offered as PATH 525 and CLBY 525.
CLBY 526. Cell Biology and Human Disease. 3 Units.
This course is designed to provide broad base of knowledge regarding
cell structure and function. The basic structure of the cell will be
discussed, as will the various functional systems that are superimposed
upon and interact with this structure. The course will discuss organelle
biogenesis, materials movement inside cells, cell interaction with the
external environment, cell cycle and cell death regulation, cytoskeleton
dynamics, quality control mechanisms, and basic signal transduction
concepts. The course will also discuss how abnormal cell function may
lead to human disease, and how basic cell function may be harnessed by
intracellular pathogens to provide favorable intracellular environments
for replication. The major goals of this course are to provide students
with a working knowledge of the cell to facilitate understanding of the
scientific literature, and to familiarize students with modern experimental
approaches in cell biology. The course will rely heavily on student
participation. Students will be provided with study guides with the
expectation they will come to class prepared to lead interactive group
discussions with minimal input from instructors. Offered as CLBY 526,
MBIO 526 and MVIR 526.

CLBY 599. RNA Structure and Function. 3 Units.
This course will cover fundamental aspects of modern RNA biology
with emphasis on the interplay of three dimensional structure of nucleic
acids and their function. The main focus of the course is on the recent
discoveries that indicate a prominent role of RNA as a major regulator of
cellular function. Topics discussed will include an introduction to RNA
structure, folding and dynamics, RNA/RNA and RNA-protein interactions,
and role of RNA in catalysis of biological reactions in ribosome and the
role of other catalytic RNAs in tRNA biogenesis, pre-mRNA splicing, and
viral replication. The course also covers the recently discovered RNA
regulatory switches, large noncoding regulatory RNAs, and the role of
RNA in human diseases and novel, RNA-based therapeutics. Offered as
BIOC 599, CLBY 599, and MBIO 599.

CLBY 601. Special Problems. 1 - 18 Units.
This is the listing for independent research. Students should enroll in
this course once they have selected their laboratory for Ph.D. research.
The number of credit hours depends on how many didactic courses they
are following at the same time. Once they have passed their qualifying
examination they should register for CLBY 701.

CLBY 701. Dissertation Ph.D.. 1 - 9 Units.
This is the listing for independent research toward the Ph.D. The number of
credit hours depends on how many didactic courses students are
following at the same time. Students may register for this course only
once they have passed their qualifying examination. Prereq: Predoctoral
research consent or advanced to Ph.D. candidacy milestone.

MBIO Courses

MBIO 399. Undergraduate Research. 1 - 3 Units.
Permits qualified undergraduates to work in a faculty member's
laboratory.

MBIO 420. Current Topics in Cancer. 3 Units.
The concept of cancer hallmarks has provided a useful guiding principle
in our understanding of the complexity of cancer. The hallmarks include
sustaining proliferative signaling, evading growth suppressors, enabling
replicative immortality, activating invasion and metastasis, inducing
angiogenesis, resisting cell death, deregulating cellular energetics,
avoiding immune destruction, tumor-promoting inflammation, and
genome instability and mutation. The objectives of this course are to
(1) examine the principles of some of these hallmarks, and (2) explore
potential therapies developed based on these hallmarks of cancer. This
is a student-driven and discussion-based graduate course. Students
should have had some background on the related subjects and have read
scientific papers in their prior coursework. Students will be called on to
present and discuss experimental design, data and conclusions from
assigned publications. There will be no exams or comprehensive papers
but students will submit a one-page critique (strengths and weaknesses)
of one of the assigned papers prior to each class meeting. The course
will end with a full-day student-run symposium on topics to be decided
jointly by students and the course director. Grades will be based on class
participation, written critiques, and symposium presentations. Offered
as BIOT 420, MBIO 420, PATH 422, and PHRM 420. Prereq: CBIO 453 and
CBIO 455.

MBIO 435. Seminar in Molecular Biology/Microbiology. 1 Unit.
Graduate students will attend the departmental seminar given by
all graduate students in the Department of Molecular Biology and
Microbiology, in the Molecular Virology Program, and in the Cell Biology
Program, as well as give a seminar on their own thesis research. Students
will be evaluated by the faculty member in charge of that student’s
seminar with input from the students’ own thesis committee. After each
seminar, the student presenter will meet with other graduate students
for peer-review of the content, delivery, and style of the seminar. Peer
reviewers will also be evaluated for the quality of their input. Offered as
MBIO 435 and MVIR 435. Prereq: CBIO 453 and CBIO 455.

3 Units.
Through a combination of lectures by Case faculty and guest lecturers,
along with student discussion of current literature, this course
emphasizes mechanisms of viral gene expression and pathogenesis.
RNA viruses to be discussed include positive, negative, and retroviruses.
DNA viruses include SV40, adenovirus, herpes, papilloma, and others.
Important aspects of host defense mechanisms, antiviral agents, and
viral vectors will also be covered. Students will be evaluated based on
their quality of presentation of course papers assigned to them and
their overall participation in class discussions. Offered as MBIO 445 and
MVIR 445.
MBIO 450. Cells and Pathogens. 3 Units.
Modern molecular cell biology owes a great debt to viral and bacterial pathogens as model systems. In some instances pathogens operate by faithful mimicry of host proteins, and other cases represent the result of extensive molecular tinkering and convergent evolution. This course will also explore numerous mechanisms utilized by pathogens to subvert the host and enhance their own survival. Topics covered include nuclear regulatory mechanisms, protein synthesis and stability, membrane-bound organelles, endocytosis and phagocytosis, and factors that influence cell behavior such as cytoskeleton rearrangements, cell-cell interactions, and cell migration. Additional topics include cell signaling and co-evolution of pathogens and host cell functions. Students are expected to come to class prepared to discuss pre-assigned readings consisting of brief reviews and seminal papers from the literature. Student assessment will be based on effective class participation (approximately 80%) and successful presentation of an independent research topic (approximately 20%). Offered as CLBY 450, MBIO 450, and MVIR 450. Prereq: CBIO 453 and CBIO 455 or permission of instructor.

MBIO 488. Yeast Genetics and Cell Biology. 3 Units.
This seminar course provides an introduction to the genetics and molecular biology of the yeasts S. cerevisiae and S. pombe by a discussion of current literature focusing primarily on topics in yeast cell biology. Students are first introduced to the tools of molecular genetics and special features of yeasts that make them important model eukaryotic organisms. Some selected topics include cell polarity, cell cycle, secretory pathways, vesicular and nuclear/cytoplasmic transport, mitochondrial import and biogenesis, chromosome segregation, cytoskeleton, mating response and signal transduction. Offered as CLBY 488, GENE 488, MBIO 488, and PATH 488.

MBIO 513. Bacterial Virulence and Host Interactions. 3 Units.
The goal of this seminar course is to familiarize students with bacterial virulence mechanisms and how they interact with the host. The focus will be on current literature pertaining to this field. While the molecular basis of bacterial virulence mechanisms will be the main focus, some time will be spent on the host immune response. Topics covered will include adhesins/pili, secretion mechanisms, AB toxins, bacterial invasion and intracellular survival, regulation of virulence gene expression. Prereq: CBIO 453 and CBIO 455 or equivalent courses.

MBIO 519. Molecular Biology of RNA. 3 Units.
Selected topics regarding editing, enzymatic function, splicing, and structure of RNA. Offered as BIOL 519, CLBY 519, and MBIO 519.

MBIO 526. Cell Biology and Human Disease. 3 Units.
This course is designed to provide broad base of knowledge regarding cell structure and function. The basic structure of the cell will be discussed, as will the various functional systems that are superimposed upon and interact with this structure. The course will discuss organelle biogenesis, materials movement inside cells, cell interaction with the external environment, cell cycle and cell death regulation, cytoskeleton dynamics, quality control mechanisms, and basic signal transduction concepts. The course will also discuss how abnormal cell function may lead to human disease, and how basic cell function may be harnessed by intracellular pathogens to provide favorable intracellular environments for replication. The major goals of this course are to provide students with a working knowledge of the cell to facilitate understanding of the scientific literature, and to familiarize students with modern experimental approaches in cell biology. The course will rely heavily on student participation. Students will be provided with study guides with the expectation they will come to class prepared to lead interactive group discussions with minimal input from instructors. Offered as CLBY 526, MBIO 526 and MVIR 526.

MBIO 537. Microscopy-Principles and Applications. 3 Units.
This course provides an introduction to various types of light microscopy, digital and video imaging techniques, and their applications to biological and biomedical sciences via lectures and hands-on experience. Topics covered include geometrical and physical optics; brightfield, darkfield, phase contrast, DIC, fluorescence and confocal microscopes; and digital image processing. Offered as GENE 537, MBIO 537, and PHOL 537.

MBIO 599. RNA Structure and Function. 3 Units.
This course will cover fundamental aspects of modern RNA biology with emphasis on the interplay of three dimensional structure of nucleic acids and their function. The main focus of the course is on the recent discoveries that indicate a prominent role of RNA as a major regulator of cellular function. Topics discussed will include an introduction to RNA structure, folding and dynamics, RNA/RNA and RNA-protein interactions, and role of RNA in catalysis of biological reactions in ribosome and the role of other catalytic RNAs in RNA biogenesis, pre-mRNA splicing, and viral replication. The course also covers the recently discovered RNA regulatory switches, large noncoding regulatory RNAs, and the role of RNA in human diseases and novel, RNA-based therapeutics. Offered as BIOL 599, CLBY 599, and MBIO 599.

MBIO 601. Research in Molecular Biology and Microbiology. 1 - 18 Units.
MBIO 701. Dissertation Ph.D.. 1 - 9 Units.

MVIR Courses

MVIR 435. Seminar in Molecular Biology/Microbiology. 1 Unit.
Graduate students will attend the departmental seminar given by all graduate students in the Department of Molecular Biology and Microbiology, in the Molecular Virology Program, and in the Cell Biology Program, as well as give a seminar on their own thesis research. Students will be evaluated by the faculty member in charge of that student’s seminar with input from the students’ own thesis committee. After each seminar, the student presenter will meet with other graduate students for peer-review of the content, delivery, and style of the seminar. Peer reviewers will also be evaluated for the quality of their input. Offered as CLBY 435 and MBIO 435 and MVIR 435.

MVIR 445. Molecular Biology and Pathogenesis of RNA and DNA Viruses. 3 Units.
Through a combination of lectures by Case faculty and guest lecturers, along with student discussion of current literature, this course emphasizes mechanisms of viral gene expression and pathogenesis. RNA viruses to be discussed include positive, negative, and retroviruses. DNA viruses include SV40, adenovirus, herpes, papilloma, and others. Important aspects of host defense mechanisms, antiviral agents, and viral vectors will also be covered. Students will be evaluated based on their quality of presentation of course papers assigned to them and their overall participation in class discussions. Offered as MBIO 445 and MVIR 445. Prereq: CBIO 453 and CBIO 454 and CBIO 455 and CBIO 456.
MVIC 450. Cells and Pathogens. 3 Units.
Modern molecular cell biology owes a great debt to viral and bacterial pathogens as model systems. In some instances pathogens operate by faithful mimicry of host proteins, and other cases represent the result of extensive molecular tinkering and convergent evolution. This course will also explore numerous mechanisms utilized by pathogens to subvert the host and enhance their own survival. Topics covered include nuclear regulatory mechanisms, protein synthesis and stability, membrane-bound organelles, endocytosis and phagocytosis, and factors that influence cell behavior such as cytoskeleton rearrangements, cell-cell interactions, and cell migration. Additional topics include cell signaling and co-evolution of pathogens and host cell functions. Students are expected to come to class prepared to discuss pre-assigned readings consisting of brief reviews and seminal papers from the literature. Student assessment will be based on effective class participation (approximately 80%) and successful presentation of an independent research topic (approximately 20%). Offered as CLBY 450, MBIO 450, and MVIC 450. Prereq: CBIO 453 and CBIO 455 or permission of instructor.

MVIC 526. Cell Biology and Human Disease. 3 Units.
This course is designed to provide broad base of knowledge regarding cell structure and function. The basic structure of the cell will be discussed, as well the various functional systems that are superimposed upon and interact with this structure. The course will discuss organelle biogenesis, materials movement inside cells, cell interaction with the external environment, cell cycle and cell death regulation, cytoskeleton dynamics, quality control mechanisms, and basic signal transduction concepts. The course will also discuss how abnormal cell function may lead to human disease, and how basic cell function may be harnessed by intracellular pathogens to provide favorable intracellular environments for replication. The major goals of this course are to provide students with a working knowledge of the cell to facilitate understanding of the scientific literature, and to familiarize students with modern experimental approaches in cell biology. The course will rely heavily on student participation. Students will be provided with study guides with the expectation they will come to class prepared to lead interactive group discussions with minimal input from instructors. Offered as CLBY 526, MBIO 526 and MVIC 526.

MVIC 601. Research. 1-18 Units.
Grade of S/U only.

MVIC 701. Dissertation Ph.D.. 1-9 Units.
Grade of S/U only. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Molecular Medicine Program
Lerner Research Institute, ND-46
http://www.lerner.ccf.org/molecmed/phd/
Phone: 216.445.9417
Jonathan Smith, PhD, Chair

The Molecular Medicine PhD Program is a unique collaborative graduate training opportunity that integrates medical knowledge into graduate training. The goal of this program is to produce scientists trained in translational research: basic or applied research relevant to human health and disease that can lead to new understanding of disease, clinical and diagnostic tools, medications, and therapies.

Students train rigorously to apply basic science discoveries to human health and to the causes and treatments of human disease. The mastery of competencies necessary to translate scientific observations from the research bench to clinical care is the focus of this PhD program. Graduates will be well prepared to collaborate with physicians and for the challenge of using molecular and cellular biology to advance human health.

PhD in Molecular Medicine
Admission into the Molecular Medicine PhD program is obtained through application directly to the program. Graduate students complete didactic coursework, independent research, and other doctoral requirements to earn the PhD. First year students complete two to four laboratory rotations among the laboratories of training faculty, and are exposed to trainer research projects during the Frontiers of Molecular Medicine seminars. The first year begins mid-July. Students from all years present their research and received feedback in the Student Seminar Series.

During subsequent years, students will devote the majority of their time to thesis research while attending advanced graduate courses, and seminars. Advanced elective courses may be chosen from any department or program on campus with the approval of the graduate program director and the student’s thesis committee over the first two years. Students must take a total of 36 semester hours of courses and pre-candidacy thesis research, including 24 graded credit hours, and maintain a B average.

The qualifying exam will be comprised of preparing and defending a grant application in the NIH format. The topic of the grant is the area of the student’s thesis research. At least one aim of this proposal will consist of a specific translational or clinical aim.

All efforts should be made to complete the PhD within five years from the date of matriculation. All students are expected to submit two or more first-authored primary research publications in peer-reviewed scientific journals. At least one manuscript must be accepted for publication prior to the thesis defense.

PhD Program Requirements
Coursework
Students begin in July by taking MMED 402 Tools for Research and MMED 410 Introduction to Human Physiology and Disease. The student will follow a progressive curriculum including Cell Biology; Metabolism and Pharmacology; Nucleic Acids, Gene Expression and Gene Regulation; Mammalian Genetics; and Infection and Immunity. In the second summer students take Principles of Clinical and Translational Research. During year 2, students are required to take MMED 521, focusing on molecular mechanisms of human disease, and an independent study mentored MMED 612 Clinical Experience.

Research Rotations
The research rotations allow the student to sample areas of research and become familiar with faculty members and their laboratories. The main purpose of these rotations is to aid the student in selecting a laboratory for the thesis work. Students will begin their rotations in July. At least two rotations are highly recommended prior to choosing the thesis advisor.

Choosing a Thesis Advisor
During or after the second semester of the first year, students select an advisor for their dissertation research. The emphasis of the PhD work is on research, culminating in the completion of an original, independent research thesis.

Plan of Study
Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045).
First Year

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<td>Cell Biology (MMED 415)</td>
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<td>Nucleic Acids, Gene Expression, and Gene Regulation (MMED 413)</td>
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<td>Mammalian Genetics (MMED 414)</td>
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<td>Host Defense: Infection and Immunity (MMED 416)</td>
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Second Year

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Third Year

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<td>Advanced Electives (if necessary)**</td>
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</table>

**Total Units in Sequence:** 38-54

* Starts in July
** Credits vary
+ Credits may vary to yield 9 credits per semester

Third Year and beyond: Complete elective coursework so that total graded courses less than or equal to 24 credits; Research credits switch from MMED 601 to MMED 701 once passed into candidacy. Minimum of 1 credit of 701 is required each regular semester thereafter for a total of 18 credits to graduate.

Courses

MMED 400. Research Rotations. 0 Unit.
Research rotations are conducted to expose the student to several laboratory environments, a variety of research problems and numerous laboratory techniques as well as to assist them in the selection of their Research Advisor. Rotations will begin immediately upon enrollment and continue through the second semester of the first year. Usually rotations will last 12 weeks, however if a student decides that he/she is not interested in the assigned laboratory a shorter rotation is appropriate. The student is responsible for arranging each rotation with an approved trainer with the consultation of the Graduate Program Director. To assist in this endeavor, the Graduate Program Director will provide a list of approved trainers who have space, time and money to support a graduate student. During the rotation, students are expected to participate in all lab and departmental activities, e.g., lab meetings and seminars. At the completion of a rotation the student is required to submit a written Rotation Report including an outline of the problem being studied, a description of the experimental approaches, a discussion of the results of performed experiments as well as future directions.

MMED 402. Tools for Research. 2 Units.
The goal of this course is to provide a thorough and comprehensive review of current laboratory technology essential to research in molecular medicine, focusing on basic underlying principles, important controls and caveats. The students will clone a cytokine during a laboratory component of the course, which will involve designing appropriate primers, obtaining RNA from cytokine-expressing cells, performing RT/PCR, and ligating isolated, characterized fragments into cloning- and expression vectors, followed by transfection into mammalian cells. Additional bench work will include characterizing the cloned product using real time PCR, ELISA, western blot analysis, and immunohistochemistry. Seminars on commonly used molecular techniques will be given intermittently by guest lecturers with the relevant expertise. Evaluation will be based on the student’s lab techniques, class participation, and contribution to the group learning process.

MMED 404. Journal Club / Frontiers in Molecular Medicine. 1 Unit.
This course is a combination of a weekly discussion-based Journal Club with selected articles relevant to the core curriculum of the week and the Frontiers in Molecular Medicine Seminar series. The seminars are presented by Molecular Medicine faculty and guest lecturers to introduce first year students to the opportunities and issues in translational and clinical research.

MMED 410. Introduction to Human Physiology and Disease. 4 Units.
The purpose of this course is to give an introduction to the physiology of the major human organ systems, as well as selected associated pathophysiology. The course will provide a physiological basis for subsequent study and research in Molecular Medicine. The integration of clinical faculty into the course will emphasize the importance of bringing scientific knowledge to bear on clinical problems, a theme which will be stressed throughout the Molecular Medicine curriculum. The course will also acquaint students with medical terminology.

MMED 412. Metabolism and Introduction to Principles of Pharmacology. 2 Units.
The course will include a combination of interactive lectures, research presentations, related journal club article, and group projects with presentations. Topics to be covered include: bioenergetics/oxidative phosphorylation, carbohydrate metabolism; lipid and lipoprotein metabolism, amino acid and nucleotide metabolism; integrative regulation of metabolism; and principals of pharmacology.
MMED 413. Nucleic Acids, Gene Expression, and Gene Regulation. 2 Units.
The course will include a combination of interactive lectures and problem-based learning. Each week will conclude with at least one clinical correlation where the weekly topic is presented in the context of a clinical problem. Topics to be covered include: DNA structure, chromosome structure, replication and repair; RNA synthesis and RNA processing, the organization of eukaryotic genes and the genetic code and translation; and gene regulation.

MMED 414. Mammalian Genetics. 2 Units.
The course focuses on genetics, genomics, and bioinformatics, and it will include a combination of interactive lectures, problem-based learning and a week-long group project. Topics to be covered include: genetic variation, linkage studies; association studies; complex traits, linkage disequilibrium, the Hap Map, pharmacogenetics; genome-wide expression studies, and mouse models of human disease, and bioinformatics.

MMED 415. Cell Biology. 2 Units.
The course will include a combination of interactive lectures and problem-based learning. Each week will conclude with at least one clinical correlation where the weekly topic is presented in the context of a clinical problem. Topics to be covered include: cell structure and organelles, prokaryotes/eukaryotes; intracellular compartments and protein sorting; receptors/endocytosis/rafts; the nucleus; cell communication; and mechanics of cell division.

MMED 416. Host Defense: Infection and Immunity. 2 Units.
The course will include a reading program, lectures, and weekly problem-based student-led presentations. Weeks 1 and 2 are dedicated to establishing the scope of the field and forming vocabulary. Week 3 and part of Week 4 will cover immune mechanisms. The remainder of the course will deal with clinical aspects of immunobiology. On a regular basis Clinical Correlations, relevant to weekly topics, are integrated into the material. Topics to be covered include: biology and molecular biology of infectious agents; fundamentals of immunology; innate and adaptive responses to infection, immune effector mechanisms; and clinical aspects of immunobiology.

MMED 501. Principles of Clinical and Translational Research. 4 Units.
To give an introduction to the ethical, statistical, methodologic and informatics basis of clinical and translational research. Topics will include the history of clinical and translational research, regulatory aspects of human subjects research, clinical trials study design, conflicts of interest, human subjects recruitment, research and publication ethics, technology transfer, biobank construction and utilization, and clinical and research database construction and utilization. In addition, students will be introduced to principles of biostatistics and clinical epidemiology relevant to clinical and translational research and gain expertise in statistical tool using problem based learning sets.

MMED 504. Student Seminar Series. 1 Unit.
This course is designed as a weekly seminar series that will include presentations by the MMED graduate students. The format will be as follows: seminar talks by students in years 3 and beyond to provide a research update presentations by second year students involving basic science-clinical case translation topics, and short presentations on lab rotation accomplishments by first year students. The primary goals of this series are to gain experience and improve oral presentation skills, to share results and thoughts with peers during research discussions, and to learn to take the lead in developing and asking questions during seminars.

MMED 521. Molecular aspects of the diagnosis, pathology, and treatment of selected human diseases. 3 Units.
The goal of this course is to integrate medical knowledge into PhD training. This team-taught seminar course focuses on a top down examination of selected human diseases starting with clinical presentations of the manifestations, diagnoses, and treatment of disease. This is followed by study of the pathology, cell biology, and molecular biology of the disease. This information forms the foundation of a final discussion of current treatment strategies and ongoing research to identify new strategies. Three to four separate disease areas will be discussed during each semester, such as diabetes, cancer, and cardiovascular diseases. The specific areas of discussion are selected to demonstrate the strength of an integrated team of clinical and basic scientists; and to provide a model for students to follow in future studies in their own area of expertise. Emphasis will be given to the basic scientific observations that formed the basis of successful clinical practice, and how this was utilized by integrated teams of basic and clinical investigators to provide better patient care. Students will prepare for discussions with close reading of the literature. Faculty will present an overview in a discussion format. It is anticipated that each disease area will be presented by an integrated team of clinical and basic scientists. The final weeks of the semester will be devoted to student preparation of a research proposal based upon the information discussed during the course. The specific topic of this proposal will be of the students choosing. Grading will be based both upon preparation for and participation in discussions, and upon the research proposal. Recommended Preparation: Introductory Graduate or Medical School courses in Cell Biology, Molecular Biology, and Physiology

MMED 601. Dissertation Research. 1 - 9 Units.
Research leading toward the Ph.D. dissertation in Molecular Medicine.

MMED 612. Clinical Experience. 2 Units.
Each student will be assigned a Clinical Mentor who will co-advice the student and serve on both the Qualifying Examination Committee and Thesis Committee. The Clinical Mentor will develop an individualized curriculum for the student in consultation with the Thesis Research Mentor and Program Director. The curriculum will be organized around the integrated, multidisciplinary disease groups at the Clinic. The students will attend and actively participate in the regularly scheduled multidisciplinary clinical conference organized by their disease group (most meet for one hour every week or every other week), usually involving a combination of case presentations and research presentations. At the conclusion of the semester the student will make a presentation to the group focused on a relevant translational research problem. The Clinical Mentor will also organize a series of supervised clinical experiences (with a Mentor) to various locations where students will observe clinician interactions with patients to better understand the disease from the patient perspective and to disease-related diagnostic and research laboratories.

MMED 701. Dissertation Ph.D.. 1 - 9 Units.
Research leading toward the Ph.D. dissertation in Molecular Medicine. Recommended preparation: Advancement to candidacy in MMED. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Neurosciences
Room E-653, School of Medicine, Robbins Building
http://case.edu/medicine/neurosciences/
Phone: 216.368.6252; Fax: 216.368.4650
Evan Deneris, PhD, Interim Chair
evan.deneris@case.edu
Katie Wervey (kathleen.wervey@case.edu), Department Assistant

Understanding how the nervous system develops and functions to process information and mediate behavior and how it is altered by disease, injury and the environment is one of the most exciting frontiers remaining in biological science. Neuroscience is inherently multidisciplinary and integrative and solving the major outstanding problems will require knowledge of molecular, cellular, systems, and behavioral levels of organization. It also requires a multidisciplinary approach combining the tools of electrophysiology, anatomy, biochemistry and molecular biology in studies of animals, brain slices, and tissue culture models.

The department offers a PhD program that provides interdisciplinary training in modern neurosciences through a combination of course work, seminars and research experience. Medical students are encouraged to pursue research projects with neurosciences faculty. Neuroscientists at CWRU are using state-of-the art techniques and instrumentation to study diverse aspects of nervous system function, including neural circuitry and plasticity, development and regeneration, and cellular and molecular neurobiology. Techniques used include electrical recording and imaging to study the behavior of neurons from ion channels to how they function in awake, behaving animals; molecular genetic approaches to discover the roles of specific genes in circuit formation, synaptic function, and in neurological disorders; and anatomical, biochemical, computational, and behavioral methods to understand the normal nervous system and how it is affected by disease and injury.

### PhD in Neurosciences

The Neurosciences graduate program has a strong emphasis on cellular and molecular mechanisms that mediate the function and development of the nervous system. Admissions to the Neurosciences PhD program may be obtained through the integrated Biomedical Sciences Training Program or via the Medical Scientist Training Program. To earn a PhD in Neurosciences, a student must complete rotations in at least three laboratories, followed by selection of a research advisor, and complete Core and Elective coursework including responsible conduct of research as described in the plan of study, below. In general, students must be registered for a total of 9 credit hours each fall and spring semester until they advance to candidacy, at the end of their 2nd year. Students who previously completed relevant coursework, for example, with a MS, may petition to complete alternative courses. Each graduate program follows the overall regulations established and described in CWRU Graduate Studies and documented to the Regents of the State of Ohio.

In addition, each student must successfully complete a preliminary exam after year one, and a qualifier examination for advancement to candidacy in the form of a short grant proposal with oral defense. The qualifier is generally completed in the summer after year two. During the dissertation period, students are expected to meet at least once a year with their thesis committee, present seminars in the department, and fulfill journal publication requirements. Throughout the doctoral training, students are expected to be enthusiastic participants in seminars, journal clubs, and research meetings in the lab and program. Completion of the PhD degree will require 36 hours of coursework (24 hours of which are graded) and 18 hours of NEUR 701 Dissertation Ph.D.

### Plan of Study

Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045)

### First Year

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<td>Molecular Biology I (CBIO 455)</td>
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<td>Neuroscience Seminars (NEUR 415)</td>
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<td>Research in Neuroscience (NEUR 601)</td>
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<td>Principles of Neural Science (NEUR 402)</td>
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<td>On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)</td>
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Courses

NEUR 402. Principles of Neural Science. 3 Units.
Lecture/discussion course covering concepts in cell and molecular neuroscience, principles of systems neuroscience as demonstrated in the somatosensory system, and fundamentals of the development of the nervous system. This course will prepare students for upper level Neuroscience courses and is also suitable for students in other programs who desire an understanding of neurosciences. Recommended preparation: CBIO 453. Offered as BIOL 402 and NEUR 402.

NEUR 405. Cellular and Molecular Neurobiology. 3 Units.
Cell biology of nerve cells, including aspects of synaptic structure physiology and chemistry. The application of molecular biological tools to questions of synaptic function will be addressed. Recommended preparation: BIOL 473. Offered as BIOL 402 and NEUR 402.

NEUR 415. Neuroscience Seminars. 1 Unit.
Current topics of interest in neurosciences. Students attend weekly seminars. From this series, students prepare critiques. No credit is given for less than 75% attendance.

NEUR 419. Critical Thinking in Neuroscience. 3 Units.
The goal of this course is to develop the student's critical reasoning skills through reading and discussing primary research papers. Each year, the course will focus on 3-4 different topics selected by participating Neuroscience faculty members. Students will receive a letter grade based on their contributions to discussions, and at the discretion of the faculty, performance on exams and/or term paper. Prereq: NEUR 402.

NEUR 424. Sensory Neuroscience. 3 Units.
How do our brains and those of other animals allow for the acquisition and processing of unique sensory percepts? In what manners might sensory systems interact to enhance perception? Further, what happens to sensory system function in cases of neurological disorders? This course is a topic introduction to sensory neuroscience, a major area of modern neuroscience with connections to neurology, psychology, ethology, and related topics. Topics include visual, auditory, somatosensory, gustatory, and olfactory neuroscience. We will also examine the mechanisms and uses of magnetoreception, electroreception, echolocation, and other 'special' senses. All of the above topics will be covered under the theme of how animals actively sample their sensory environments for information. Prereq: BIOL 402 or BIOL 473 or NEUR 402 or PSCL 403 or Consent of Instructor.

NEUR 432. Current Topics in Vision Research. 3 Units.
Vision research is an exciting and multidisciplinary area that draws on the disciplines of biochemistry, genetics, molecular biology, structural biology, neuroscience, and pathology. This graduate level course will provide the student with broad exposure to the most recent and relevant research currently being conducted in the field. Topics will cover a variety of diseases and fundamental biological processes occurring in the eye. Regions of the eye that will be discussed include the cornea, lens, and retina. Vision disorders discussed include age-related macular degeneration, retinal ciliopathies, and diabetic retinopathy. Instructors in the course are experts in their field and are members of the multidisciplinary visual sciences research community here at Case Western Reserve University. Students will be exposed to the experimental approaches and instrumentation currently being used in the laboratory and in clinical settings. Topics will be covered by traditional lectures, demonstrations in the laboratory and the clinic, and journal club presentations. Students will be graded on their performance in journal club presentations (40%), research proposal (40%), and class participation (20%). Offered as NEUR 432, PATH 432, PHRM 432 and BIOL 432.

NEUR 466. Cell Signaling. 3 Units.
This is an advanced lecture/journal/discussion format course that covers cell signaling mechanisms. Included are discussions of neurotransmitter-gated ion channels, growth factor receptor kinases, cytokine receptors, G protein-coupled receptors, steroid receptors, heterotrimeric G proteins, ras family GTPases, second messenger cascades, protein kinase cascades, second messenger regulation of transcription factors, microtubule-based motility, actin/myosin-based motility, signals for regulation of cell cycle, signals for regulation of apoptosis. Offered as CLBY 466, PHOL 466 and PHRM 466.

NEUR 473. Introduction to Neurobiology. 3 Units.
How nervous systems control behavior. Biophysical, biochemical and molecular biological properties of nerve cells, their organization into circuitry, and their function within networks. Emphasis on quantitative methods for modeling neurons and networks, and on critical analysis of the contemporary technical literature in the neurosciences. Term paper required for graduate students. This course satisfies a lab requirement for the B.A. in Biology, and a Quantitative Laboratory requirements for the B.S. in Biology. Offered as BIOL 373, BIOL 473, and NEUR 473.

NEUR 474. Neurobiology of Behavior. 3 Units.
In this course, students will examine how neurobiologists interested in animal behavior study the linkage between neural circuitry and complex behavior. Various vertebrate and invertebrate systems will be considered. Several exercises will be used in this endeavor. Although some lectures will provide background and context on specific neural systems, the emphasis of the course will be on classroom discussion of specific journal articles. In addition, students will each complete a project in which they will observe some animal behavior and generate both behavioral and neurobiological hypotheses related to it. In lieu of examinations, students will complete three written assignments, including a theoretical grant proposal, a one-page Specific Aims paper related to the project, and a final project paper. These assignments are designed to give each student experience in writing biologically-relevant documents. Classroom discussions will help students understand the content and format of each type document. They will also present their projects orally to the entire class. Offered as BIOL 374, BIOL 474 and NEUR 474. Counts as SAGES Departmental Seminar.
NEUR 475. Protein Biophysics. 3 Units.
This course focuses on in-depth understanding of the molecular biophysics of proteins. Structural, thermodynamic and kinetic aspects of protein function and structure-function relationships will be considered at the advanced conceptual level. The application of these theoretical frameworks will be illustrated with examples from the literature and integration of biophysical knowledge with description at the cellular and systems level. The format consists of lectures, problem sets, and student presentations. A special emphasis will be placed on discussion of original publications. Offered as BIOL 475, CHEM 475, PHOL 475, PHRM 475, and NEUR 475.

NEUR 476. Neurobiology Laboratory. 3 Units.
Introduction to the basic laboratory techniques of neurobiology. Intracellular and extracellular recording techniques, forms of synaptic plasticity, patch clamping, immunohistochemistry and confocal microscopy. During the latter weeks of the course students will be given the opportunity to conduct an independent project. One laboratory and one discussion session per week. Recommended preparation for BIOL 476 and NEUR 476: BIOL 216. Offered as BIOL 376, BIOL 476 and NEUR 476.

NEUR 478. Computational Neuroscience. 3 Units.
Computer simulations and mathematical analysis of neurons and neural circuits, and the computational properties of nervous systems. Students are taught a range of models for neurons and neural circuits, and are asked to implement and explore the computational and dynamic properties of these models. The course introduces students to dynamical systems theory for the analysis of neurons and neural learning, models of brain systems, and their relationship to artificial and neural networks. Term project required. Students enrolled in MATH 478 will make arrangements with the instructor to attend additional lectures and complete additional assignments addressing mathematical topics related to the course. Recommended preparation: MATH 223 and MATH 224 or BIOL 300 and BIOL 306. Offered as BIOL 378, COGS 378, MATH 378, BIOL 478, EBME 478, EECS 478, MATH 478 and NEUR 478.

NEUR 482. Drugs, Brain, and Behavior. 3 Units.
This course is concerned with the mechanisms underlying neurochemical signaling and the impact of drugs on those mechanisms. The first half of the course emphasizes the fundamental mechanisms underlying intracellular and extracellular communication of neurons and the basic principles of how drugs interact with the nervous system. The second half of the course emphasizes understanding the neural substrates of disorders of the nervous system, and the mechanisms underlying the therapeutic effects of drugs at the cellular and behavioral levels. This course will consist of lectures designed to give the student necessary background for understanding these basic principles and class discussion. The class discussion will include viewing video examples of behavioral effects of disorders of the nervous system, and analysis of research papers. The goal of the class discussions is to enhance the critical thinking skills of the student and expose the student to contemporary research techniques. Offered as BIOL 382, BIOL 482, and NEUR 482.

NEUR 540. Advanced Topics in Neuroscience Ethics. 0 Unit.
This course offers continuing education in responsible conduct of research for advanced graduate students. The course will cover the nine defined areas of research ethics through a combination of lectures, online course material and small group discussions. Six 2-hr meetings per semester. Maximum enrollment of 15 students with preference given to graduate students in the Neurosciences program. All neurosciences graduate students must complete this course during their 3rd or 4th year.

NEUR 601. Research in Neuroscience. 1 - 18 Units.

NEUR 651. Master's Thesis (M.S.). 1 - 6 Units.
(Credit as arranged.) Recommended preparation: M.S. candidates only.

NEUR 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Nutrition

School of Medicine, Room WG 48
https://case.edu/medicine/nutrition/
Phone: 216.368.2440; Fax: 216.368.6644
Hope Barkoukis, PhD, RD, Interim Chair
hd@case.edu

Pamela Woodruff (pamela.woodruff@case.edu), Graduate Student Coordinator

The department’s focus is on human nutrition and the application of the science of nutrition to health promotion and disease prevention. Undergraduate programs are designed for students interested in nutritional biochemistry and metabolism, clinical nutrition, professional study in dietetics, public health nutrition, medicine, physical therapy, pharmacy or dentistry. Graduate programs emphasize dietetics, public health nutrition, nutritional biochemistry and clinical nutrition.

The Department of Nutrition offers programs leading to the bachelor of arts degree in nutrition, the bachelor of science degree in nutrition, the bachelor of arts degree in nutritional biochemistry and metabolism, the bachelor of science degree in nutritional biochemistry and metabolism, the master of science degree in nutrition, the dual degree of master of public health/master of science nutrition, and the doctor of philosophy degree. Two minors are available: the minor in nutrition and the minor in sports nutrition. Graduate certificate programs are available in areas such as maternal and child nutrition, nutrition for health care professionals, global health nutrition and gerontology. The certificates are in addition to the basic graduate degree. Students are able to pursue certificates at no additional cost to the student.

Undergraduate Degrees (NTRN)

Major Programs

The undergraduate degree in nutrition is appropriate for students who wish to:

1. pursue graduate programs in nutritional biochemistry, dietetics, public health and community nutrition or other biomedical sciences
2. enter professional schools of dentistry, medicine, physical therapy, or pharmacy
3. apply to dietetic internships or approved experience programs in order to prepare for the professional practice of dietetics
4. pursue careers with the government or in the food or pharmaceutical industry

This major offers flexibility in course selection within a framework of general program requirements. The selection of courses depends on the student’s choice of emphasis. Students wishing to qualify for admission to professional or graduate programs need to include specific courses considered prerequisites for admission. Students interested in applying to dietetic internships must meet specific course requirements (Didactic Program in Dietetics) as required by the Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and
Dietetics. These requirements are met in the courses that comprise the Didactic Program in Dietetics (DPD). The DPD at Case Western Reserve University is currently granted Accreditation by the Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and Dietetics, 120 South Riverside Plaza, Suite 2000, Chicago, IL 60606-6995, 800.877.1600. A department advisor should be consulted in the freshman year to plan the dietetics coursework.

**Human Nutrition**

**Bachelor of Science degree requires:**

**Required Courses:**

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</tr>
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<td>NTRN 343</td>
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<td>NTRN 363</td>
<td>Human Nutrition I: Energy, Protein, Minerals</td>
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<td>NTRN 364</td>
<td>Human Nutrition II: Vitamins</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 397</td>
<td>SAGES Capstone Proposal Seminar</td>
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</tr>
<tr>
<td>NTRN 398</td>
<td>SAGES Senior Capstone Experience</td>
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Three nutrition electives chosen from:

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<td>NTRN 371</td>
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<tr>
<td>or NTRN 528</td>
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**Additional Required Courses:**

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<td>PSCL 282</td>
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<tr>
<td>PQHS 431</td>
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Total Units: 60

* Only one of these courses is permitted.
400 level courses require instructor consent for undergraduates to enroll.

**Bachelor of Arts degree requires:**

**Required Courses:**

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**Total Units:** 49

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**Bachelor of Science in Nutrition - Human Nutrition Major Example Plan of Study**

| Year Total: | 13 14 |

**Second Year**

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**Total Units:** 15 15

**Third Year**

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**Total Units:** 15 15

**Fourth Year**

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**Total Units:** 15 15

**Total Units in Sequence:** 118

**Nutritional Biochemistry and Metabolism**

**Bachelor of Arts degree requires:**

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<td>Food Science Lab</td>
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<tr>
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<td>Human Nutrition I: Energy, Protein, Minerals</td>
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<td>NTRN 364</td>
<td>Human Nutrition II: Vitamins</td>
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<td>SAGES Capstone Proposal Seminar</td>
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### Bachelor of Science degree requires:

**Required courses:**

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<td>NTRN 364</td>
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**Additional required courses:**

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<td>BIOC 307</td>
<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
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<td>BIOC 334</td>
<td>Structural Biology</td>
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**Total Units:** 77

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**Bachelor of Science degree requires:**

**Required courses:**

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<td>NTRN 364</td>
<td>Human Nutrition I: Vitamins</td>
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**Additional required courses:**

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<td>Introduction to Biochemistry: From Molecules To Medical Science</td>
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<td>Structural Biology</td>
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<td>or BIOC 312</td>
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**Total Units:** 86
### Bachelor of Arts in Nutrition - Nutritional Biochemistry and Metabolism Major Example Plan of Study

#### First Year

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#### Second Year

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#### Third Year

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#### Total Units in Sequence:

| Units | 114 |

### Minor in Nutrition

Nutrition majors are not eligible for this minor.

Non Nutrition majors may only take one minor: either Minor in Nutrition or Minor in Sports Nutrition.

#### Required courses:

<table>
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<td>NTRN 328</td>
<td>Child Nutrition, Development and Health</td>
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<td>NTRN 343</td>
<td>Dietary Patterns</td>
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<td>Food Service Systems Management</td>
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<td>Energy Dysregulation: From Obesity to Anorexia</td>
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<td>Human Nutrition I: Energy, Protein, Minerals</td>
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<td>NTRN 364</td>
<td>Human Nutrition II: Vitamins</td>
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<td>Nutrition for the Prevention and Management of Disease: Clinical Applications</td>
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#### Total Units:

| Units | 15 |

### Minor in Sports Nutrition

Nutrition majors are not eligible for this minor.

#### Required courses:

<table>
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<tr>
<td>NTRN 361</td>
<td>Energy Dysregulation: From Obesity to Anorexia</td>
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<td>NTRN 362</td>
<td>Exercise Physiology and Macronutrient Metabolism</td>
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#### Total Units:

| Units | 15 |

### Didactic Program in Dietetics (DPD)

The following courses must be included in the program.

#### Required courses:

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<tbody>
<tr>
<td>NTRN 201</td>
<td>Nutrition</td>
<td>3</td>
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</tbody>
</table>
MS in Nutrition

This degree program offers two options. For those pursuing the thesis option, 30 semester hours of a planned program of study are required, including six to nine semester hours of research, as well as a final oral defense of the thesis. The non-thesis option requires 30 semester hours and a final written, comprehensive examination.

All candidates are required to take 18 semester hours of nutrition, including seven hours of advanced human nutrition. In addition, students are encouraged to pursue complementary studies in the biomedical, social and behavioral sciences. The plan of study may vary considerably depending on the education, goals and specific interests of each student. Students may elect to focus on nutritional biochemistry and metabolism or molecular nutrition. The individual program also may be planned to fulfill the academic requirements for dietetic registration (Didactic Program in Dietetics).

MS in Public Health Nutrition Dietetic Internship Program

The primary goal of this program is to prepare Registered Dietitian Nutritionists (RDNs) for employment in public health or community agencies. A minimum of 30 semester hours of combined academic work and supervised practice is required to earn the degree. Supervised practice is concurrent with coursework utilizing local agencies for translation of theory and science into practice. The program includes a ten - twelve week experience in an out of town public health agency that has a strong nutrition program.

In addition to the public health nutrition curriculum, students may elect to complete a certificate in Maternal and Child Nutrition or Gerontology. Specialty certificates may require completion of additional coursework. If a certificate program is selected, supervised practice will be geared toward the specific population group.

Upon completion of the program, students are eligible to take the Registered Dietitian Nutritionist (RDN) exam. The program is accredited by the Accreditation Council for Education in Nutrition and Dietetics (ACEND). This program is a non-thesis program of study.

MS in Public Health Nutrition Dietetic Internship Program

General Track: Plan of Study

Note: Students must take either NTRN 436 or NTRN 440.

<table>
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<th>Spring</th>
<th>Summer</th>
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<tbody>
<tr>
<td>Introduction to Public Health Nutrition (NTRN 528)</td>
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<td>Nutritional Epidemiology (NTRN 529)</td>
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<td>Nutrition for the Aging and Aged (NTRN 440)</td>
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<td>NTRN 531 Public Health Nutrition Field Experience</td>
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Total Units 61
Advanced Public Health Nutrition Field Experience (NTRN 534)  
Year Total: 13 8 3

Second Year  
<table>
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<th>Units</th>
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<tbody>
<tr>
<td>Pediatric Nutrition (NTRN 436)</td>
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<tr>
<td>NTRN 531 Public Health Nutrition Field Experience</td>
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<tr>
<td>Or Elective at 400 level or higher.</td>
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Total Units in Sequence: 33

Combined Dietetic Internship/Master’s Degree Program

The Combined Dietetic Internship/Master’s Degree Program combines academic work with clinical practice at a dietetic internship at University Hospitals Case Medical Center, the Louis Stokes Cleveland Department of Veterans Affairs Medical Center, or the Cleveland Clinic. A minimum of 30 semester hours is required. Admission is contingent on the student being selected and matched to one of the hospitals’ dietetic internship programs. Appointment to these internships follows the admission procedure outlined by the Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and Dietetics.

Coursework is planned individually with the student’s academic advisor. This program is a non-thesis program of study.

First Year  
<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
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<tbody>
<tr>
<td>Seminar in Dietetics I (NTRN 516)</td>
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<tr>
<td>NTRN 561 Investigative Methods in Nutrition</td>
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<tr>
<td>Seminar in Dietetics II (NTRN 517)</td>
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<td>Research Practicum (NTRN 562)</td>
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Second Year  
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<td>Electives: Any NTRN 400, 500, or 600 level courses and/or graduate course in basic science or social science</td>
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Third Year  
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<tr>
<th>Units</th>
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<th>Spring</th>
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<tbody>
<tr>
<td>Nutritional Biochemistry and Metabolism (NTRN 452)</td>
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<tr>
<td>Public Health Capstone Experience (MPHP 652)</td>
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<tr>
<td>NTRN Elective</td>
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<tr>
<td>Public Health Capstone Experience (MPHP 652)</td>
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<tr>
<td>Master’s Comprehensive Exam (EXAM 600)</td>
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<td>Year Total:</td>
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</table>

Total Units in Sequence: 61

The trained graduate could be employed in a wide variety of settings, including (but not limited to) local, state, national, or global public policy, governmental public health, hospital outreach, community-based health non-profit organizations, health organizations, research projects; or the Food and Drug Administration. Additionally, these graduates could serve as health emissaries to foreign countries regarding nutrition, sufficient food supply, sanitary environment, food safety, oral rehydration, or the advisability of food supplements.

The MPH/Nutrition dual degree is envisioned with students able to apply for either degree, then later join the other; or apply directly for the joint degree. Both the MPH and MS programs confer degrees through the School of Graduate Studies and as such are subject to Graduate Studies rules and procedures. Both programs are housed in the School of Medicine. This program is a non-thesis program of study.

Master of Public Health/Master of Science in Nutrition Dual Degree Program

This is a dual degree program that is offered jointly by the Departments of Epidemiology and Biostatistics, and Nutrition. The core Master Degree courses include a mixture of those from nutrition, biochemistry and public health.
MD/MS Biomedical Investigation-Nutrition Track

For Admissions and MD requirements, see the MD Dual Degree Programs section (p. 724). This track is designed to provide medical students with more in-depth knowledge and research experience in nutrition. Students may elect to focus on nutrition biochemistry and metabolism or molecular nutrition or clinical nutrition. The student’s mentor or the Graduate Program Director will assist the student in selecting the appropriate courses for their interests.

Students in Nutrition must complete:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>NTRN 551</td>
<td>Seminar in Advanced Nutrition</td>
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<tr>
<td>NTRN 601</td>
<td>Special Problems</td>
<td>1 - 18</td>
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<tr>
<td>IBIS 600</td>
<td>Exam in Biomedical Investigation</td>
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<td>IBIS 401</td>
<td>Integrated Biological Sciences I</td>
<td>1 - 9</td>
</tr>
<tr>
<td>IBMS 500</td>
<td>On Being a Professional Scientist: The Responsible Conduct of Research</td>
<td>1</td>
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And 9-10 credits or three courses from those listed below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>NTRN 433</td>
<td>Advanced Human Nutrition I</td>
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</tr>
<tr>
<td>NTRN 434</td>
<td>Advanced Human Nutrition II</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 435</td>
<td>Nutrition during Pregnancy and Lactation</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 436</td>
<td>Pediatric Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 438</td>
<td>Dietary Supplements</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 439</td>
<td>Food Behavior: Physiological, Psychological and Environmental Determinants</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 440</td>
<td>Nutrition for the Aging and Aged</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 452</td>
<td>Nutritional Biochemistry and Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 448</td>
<td>Integrative and Functional Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>NTRN 459</td>
<td>Diabetes Prevention and Management</td>
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<tr>
<td>NTRN 454</td>
<td>Advanced Nutrition and Metabolism: Investigative Methods</td>
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<tr>
<td>NTRN 455</td>
<td>Molecular Nutrition</td>
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<tr>
<td>NTRN 460</td>
<td>Sports Nutrition</td>
<td>3</td>
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<tr>
<td>NTRN 461</td>
<td>Energy Dysregulation: From Obesity to Anorexia</td>
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</tr>
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<td>NTRN 529</td>
<td>Nutritional Epidemiology</td>
<td>3</td>
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<tr>
<td>NTRN 530</td>
<td>Public Health Nutrition</td>
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</tr>
<tr>
<td>NTRN 533</td>
<td>Nutritional Care of Neonate</td>
<td>3</td>
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</table>

Graduate Certificates in Nutrition

Maternal and Child Nutrition

Certificate Requirements: Degree-seeking students who are enrolled in the MS in Public Health Nutrition Internship, the Coordinated Dietetic Internship/Master’s Degree Program and the MD/MS program are eligible for this certificate. MS students are not eligible for this certificate due to the strong clinical component of the coursework.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>NTRN 435</td>
<td>Nutrition during Pregnancy and Lactation</td>
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</table>

Health Care Professionals

Certificate Requirements: A maximum of 6 credits may be double counted for this certificate and the certificate in Maternal and Child Nutrition. Students must maintain an average GPA of 3.0 to successfully complete this 15 credit certificate.

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Units</th>
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<tbody>
<tr>
<td>NTRN 401</td>
<td>Nutrition for Community and Health Care Professionals</td>
<td>2</td>
</tr>
<tr>
<td>NTRN 433</td>
<td>Advanced Human Nutrition I</td>
<td>4</td>
</tr>
<tr>
<td>NTRN 436</td>
<td>Nutrition during Pregnancy and Lactation</td>
<td>3</td>
</tr>
<tr>
<td>or NTRN 435</td>
<td>Pediatric Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>or NTRN 437</td>
<td>Evaluation of Nutrition Information for Consumers</td>
<td>0</td>
</tr>
<tr>
<td>or NTRN 438</td>
<td>Dietary Supplements</td>
<td>3</td>
</tr>
<tr>
<td>or NTRN 439</td>
<td>Food Behavior: Physiological, Psychological and Environmental Determinants</td>
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<tr>
<td>or NTRN 440</td>
<td>Nutrition for the Aging and Aged</td>
<td>3</td>
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<tr>
<td>or NTRN 446</td>
<td>Advanced Maternal Nutrition I</td>
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</tr>
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<td>or NTRN 448</td>
<td>Integrative and Functional Nutrition</td>
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<tr>
<td>or NTRN 452</td>
<td>Nutritional Biochemistry and Metabolism</td>
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<tr>
<td>or NTRN 454</td>
<td>Advanced Nutrition and Metabolism: Investigative Methods</td>
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<tr>
<td>or NTRN 455</td>
<td>Molecular Nutrition</td>
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</tr>
<tr>
<td>or NTRN 459</td>
<td>Diabetes Prevention and Management</td>
<td>3</td>
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</table>

Global Health Nutrition

Certificate Requirements: A maximum of 6 credits may be double counted for this certificate. Students must maintain an average GPA of 3.0 to successfully complete this certificate.

<table>
<thead>
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<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>INTH 401</td>
<td>Fundamentals of Global Health</td>
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<tr>
<td>PQHS 484</td>
<td>Global Health Epidemiology</td>
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<tr>
<td>NURS 494</td>
<td>Global Health Seminar</td>
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<tr>
<td>NTRN 602</td>
<td>Special Project in Nutrition</td>
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Gerontology Certificate Requirements

<table>
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<th>Course Title</th>
<th>Units</th>
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<tr>
<td>NTRN 440</td>
<td>Nutrition for the Aging and Aged</td>
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<tr>
<td>GER 498</td>
<td>Seminar in Gerontological Studies</td>
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<tr>
<td>NTRN 532C</td>
<td>Specialized Public Health Nutrition</td>
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</table>

One Gerontology Elective

Total Units 12
# PhD in Nutrition

The PhD degree in Nutrition is awarded for study and research in nutrition. Areas of concentration are nutritional biochemistry and metabolism, and molecular nutrition. Admissions to the PhD in Nutrition program are obtained through the integrated Biomedical Scientist Training Program (BSTP), by direct admission to the department or via the Medical Scientist Training Program (MSTP).

In order to earn a PhD in Nutrition, a student must complete rotations in at least three laboratories followed by selection of a research advisor, completion of Core and Elective coursework, including responsible conduct of research, as described in the plan of study. Each graduate program follows the overall regulations established and described in CWRU Graduate Studies and documented to the Regents of the State of Ohio. Completion of the PhD degree will require 36 hours of coursework (24 hours of which are graded) and 18 hours of NTRN 701 Dissertation Ph.D..

In addition, each student must successfully complete a qualifier examination for advancement to candidacy in the form of a short grant proposal with oral defense. During the dissertation period, students are expected to meet twice a year with the thesis committee, present seminars in the department, and fulfill journal publication requirements. Throughout the doctoral training, students are expected to be enthusiastic participants in seminars, journal clubs, and research meetings in the lab and program.

## Plan of Study

| Plan of Study | 
|---|---|
| Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045) | 

### First Year

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>Cell Biology I (CBIO 453)</td>
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<td>Seminar in Advanced Nutrition (NTRN 551)</td>
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<tr>
<td>Research Rotation in Biomedical Sciences Training Program (BSTP 400) or Research Rotation in Medical Scientist Training Program (MSTP 400) or Special Problems (NTRN 601)</td>
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<tr>
<td>Molecular Biology I (CBIO 455)</td>
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<tr>
<td>Advanced Human Nutrition II (NTRN 434)</td>
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<td>Advanced Nutrition and Metabolism: Investigative Methods (NTRN 454) or Molecular Nutrition (NTRN 455)</td>
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<td>Investigative Methods in Nutrition (NTRN 561)</td>
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<td>Investigative Methods in Nutrition (NTRN 561)</td>
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<td>Special Problems (NTRN 601)</td>
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### Third Year

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<tr>
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Total Units in Sequence: 41-98

After the third year, student enrolls in one credit of NTRN 701 Dissertation Ph.D., Fall and Spring Semesters until graduation.

## Courses

### NTRN 201. Nutrition. 3 Units.

The nutrients, their functions, food sources, and factors affecting human needs throughout life.

### NTRN 328. Child Nutrition, Development and Health. 3 Units.

The relationship between nutrition and physical/cognitive growth and development of the child from the prenatal period through adolescence, including individuality, maturation and biological needs. Nutritional influences (nutrient requirements, food choices, and nutritional/feeding problems) and effects on health are emphasized. Prereq: NTRN 201.
NTRN 341. Food as Medicine: How what we eat influences how we feel, think, and our health status. 3 Units.
This course will discuss key aspects of the interplay between food and health/wellness and in particular food synergy - interactions among dietary components and the effects on health. What are "whole foods" vs. basic nutrients? What are the most common nutrient deficiencies in men, women and children, including the elderly? Students will learn to interpret dietary recommendations/guidelines and which foods are used to improve digestion, optimize cardiovascular health and immune function, and help prevent cancer. Basic discussion of importance of gut micro-flora. Diet and body weight; also pros and cons of different dieting strategies. Increasing awareness of "culinary medicine" (i.e. how food acts as an integrated therapy). How what we eat influences how we feel, think and our general health status. There is an integrated culinary experience. Prereq: NTRN 201 or requisites not met permission.

NTRN 342. Food Science. 3 Units.
Chemical, physical and biological properties of food constituents and their interactions in food preparation and processing and practical application of processing methods and their effect on nutritional quality and acceptability. Prereq: CHEM 106.

NTRN 342L. Food Science Lab. 2 Units.

NTRN 343. Dietary Patterns. 3 Units.
Examination of the food supply in the United States as it is affected by production, processing, marketing, government programs, regulation, and consumer selection. Nutritional evaluation of dietary patterns of different cultures. Counts for CAS Global & Cultural Diversity Requirement. Prereq: NTRN 201.

NTRN 345. Food Service Systems Management. 3 Units.
The application of organizational theory and skills in the preparation and service of quantity food. Laboratory experience in professional food services are included. Graduate students will analyze one aspect of food service management in depth. Offered as NTRN 351 and NTRN 451. Prereq: Nutrition major or consent of instructor.

NTRN 349. Diabetes Prevention and Management. 3 Units.
In this course, we will explore the diabetes epidemic, its effects on the healthcare system, and strategies for prevention. The pathophysiology of the disease will be examined as well as environmental factors leading to the increase in diagnoses. Comorbid conditions and acute and chronic complications of diabetes and hyperglycemia will be addressed. Rationale for current therapeutic strategies will be explored, including the use of blood glucose monitoring, physical activity, nutrition counseling, oral medications, and insulin therapy. Patient education and health literacy will be studied in the context of patient centered goal setting. Requirements for developing a Diabetes Self-Management Education Program will be discussed. Community program development will be examined in the context of population-based prevention strategies. Offered as NTRN 359 and NTRN 459. Prereq: NTRN 201 and Junior or Senior Status.

NTRN 350. Clinical Assessment and Diagnosis: Nutritional, Functional, Physical. 3 Units.
Methods for the provision of nutrition services to individuals and groups. Principles of professional practice including ethics, standards, and regulatory issues. Prereq: NTRN 201 and NTRN 363 or MS in Nutrition or MS in Public Health Nutrition.

NTRN 361. Energy Dysregulation: From Obesity to Anorexia. 3 Units.
Energy imbalance and the implications on health will be explored in this course. Key concepts covered in this class include: 1. Energy imbalance refers to positive and negative states of energy balance and occurs when energy intake does not match energy expended in metabolic processes, daily living activities, and physical activity; 2. Obesity is a result of chronic positive energy balance whereas anorexia nervosa is a condition of chronic negative energy balance; 3. Energy metabolism is controlled by a complex array of neural and hormonal signaling; 4. Energy imbalance disrupts the neural and hormonal signaling pathways of energy metabolism resulting in unfavorable health consequences such as pro-inflammatory state, oxidative stress, immune dysregulation, menstrual dysfunction, sarcopenia, and low bone mineral density; and 5. Exercise training can impact energy imbalance health-related outcomes. Learning Outcomes: Students will be able to 1. define energy balance and explain the components of energy expenditure; 2. define disordered eating, female athlete triad, and disordered eating; 3. explain the relationship among energy intake, energy expenditure, and body composition in energy imbalance; 4. describe alterations in skeletal muscle and adipose physiology in energy imbalance; 5. diagram neural control of feeding and energy homeostasis and hormonal control of energy metabolism; 6. explain the neural and hormonal changes that occur in chronic energy imbalance and describe current theories in how it results in menstrual dysfunction, inflammatory response, oxidative stress, immune dysregulation, sarcopenia, and low bone mineral density; and 7. explain how exercise training can influence inflammatory response, oxidative stress, immune function, and musculoskeletal health in energy imbalance. Offered as NTRN 361 and NTRN 461. Prereq: NTRN 201 or requisites not met permission.

NTRN 362. Exercise Physiology and Macronutrient Metabolism. 3 Units.
The purpose of this course is to provide students with the knowledge of theoretical and applied concepts of exercise physiology. Students will gain an understanding of the acute and chronic physiological responses and adaptations of the cardiovascular, metabolic, hormonal, and neuromuscular systems in response to exercise. Additional topics include factors affecting performance, assessing cardiorespiratory and muscular fitness, designing exercise programs for health and wellness, special populations, and athletes, environmental considerations and nutrition's role in sport and exercise performance. Offered as NTRN 362 and NTRN 462. Prereq: NTRN 201 and BIOL 216.

NTRN 363. Human Nutrition I: Energy, Protein, Minerals. 3 Units.
Chemical and physiological properties of specific nutrients, including interrelationships and multiple factors, in meeting nutritional needs throughout the life cycle. Prereq: BIOL 216 and (Junior or Senior status).

NTRN 364. Human Nutrition II: Vitamins. 3 Units.
Chemical and physiological properties of vitamins, including interrelationships and multiple factors, in meeting nutritional needs throughout the life cycle. Prereq: NTRN 363.

NTRN 365. Nutrition for the Prevention and Management of Disease: Pathophysiology. 4 Units.
Interplay among etiology, metabolic perturbations, pathophysiology, clinical signs and symptoms, and nutrition principles for the prevention and management of disease. Prereq: NTRN 363 and BIOC 307 or equivalent or consent of instructor.
NTRN 366. Nutrition for the Prevention and Management of Disease: Clinical Applications. 3 Units.
Application of nutrition principles and knowledge for the prevention and management of disease. Case studies and other educational approaches and techniques will be used. Course includes evidence-based assessments and interpretation of key data (biochemical, dietary, physical) to develop nutritional interventions. Coreq: NTRN 365.

NTRN 367. Nutrition Strategies and Wellness Programming. 3 Units.
Wellness and its implication on nutritional choices will be explored in this class. Key concepts covered in this class include: 1. Overall wellness extends beyond smart dietary choices including social, emotional, spiritual, occupational, intellectual, and physical wellness. 2. The interrelationship among the wellness areas can alter adherence to a healthy diet. 3. Cultural differences in wellness exist and have an impact on nutritional choices. 4. Nutritional strategies must be individualized taking into account all aspects of wellness and cultural differences. 5. Interprofessional teams that include experts from each area of wellness are essential to provide optimal health care to individuals. Prereq: NTRN 201.

NTRN 371. Special Problems. 1 - 3 Units.
Independent reading, research, or special projects supervised by a member of the nutrition faculty. Prereq: Junior or senior standing.

NTRN 388. Seminar in Sports Nutrition. 3 Units.
Study of energy and nutrient needs to support recreational exercise and competitive athletics, dietary supplements and specific foods and beverages that are marketed to athletes, and how nutrition can provide optimal muscle development, recovery and sports performance. Prereq: Junior or senior standing.

NTRN 390. Undergraduate Research. 3 - 9 Units.
Guided laboratory research in nutritional biochemistry or molecular nutrition under the sponsorship of a nutrition faculty member.

NTRN 397. SAGES Capstone Proposal Seminar. 3 Units.
In this departmental seminar course, students will conceptualize, develop and prepare a written plan, known as the "Capstone Proposal," for their senior Capstone project (NTRN 398: Senior Capstone Experience). Discussion will include, but not be limited to basic research principles, different types of research, ethics and IRB procedures. The Capstone Proposal shall include the project design, aims, methodology, budget, data analysis and presentation. Upon completion of this course, students will have confirmed student/Capstone advisor and, if applicable, mentor relationships, written a Capstone proposal and given an oral presentation of their proposal at a departmental colloquium. Counts as SAGES Departmental Seminar. Prereq: NTRN 201 and NTRN 342.

NTRN 398. SAGES Senior Capstone Experience. 3 Units.
Students will implement their "Capstone Proposal" projects as designed in NTRN 397: Capstone Proposal Seminar. Pertinent research activities will depend on the nature of the student’s "Capstone Proposal" project. The student will meet regularly with their Capstone advisor, at least twice monthly, to provide progress reports, discuss the project, and for critique and guidance. By the end of this course, the student will have completed their SAGES Senior Capstone research project and presented their project results/findings orally at the Senior Capstone Fair and at a departmental colloquium. Counts as SAGES Senior Capstone. Prereq: NTRN 397.

NTRN 399. Senior Project. 3 Units.

NTRN 401. Nutrition for Community and Health Care Professionals. 2 Units.
This course will focus on understanding how diet and nutrition impact health and wellness throughout the life cycle. There are core concepts in human nutrition that all health care providers should understand to optimize their care of individuals, themselves, and the community. These core concepts are the focus of this course.

NTRN 410. Basic Oxygen & Physiological Function. 2 Units.
On-line lecture only course which explores the significance and consequences of oxygen and oxygen metabolism in living organisms. Topics to be covered include transport by blood tissues, oxygen toxicity, and mitochondrial metabolism. Emphasis will be placed on mammalian physiology with special reference to brain oxidative metabolism and blood flow as well as whole body energy expenditure and oxidative stress related to disease. The course will cover additional spans of physiology, nutrition and anatomy. Offered as NTRN 410 and PHOL 410.

NTRN 433. Advanced Human Nutrition I. 4 Units.
Emphasis on reading original research literature in energy, protein and minerals with development of critical evaluation and thinking skills. Recommended preparation: NTRN 201 and CHEM 223 and BIOL 348 or equivalent.

NTRN 434. Advanced Human Nutrition II. 3 Units.
Emphasis on reading original research literature on vitamins with development of critical evaluation and thinking skills. Recommended preparation: NTRN 433 or consent.

NTRN 435. Nutrition during Pregnancy and Lactation. 3 Units.
Study of current research literature on nutrition for pregnancy and lactation including nutrient requirements, nutrition assessment, and nutrition intervention. Prereq: Graduate Student in Nutrition or Public Health Nutrition or (NTRN 363 and NTRN 364) or requisites not met permission.

NTRN 436. Pediatric Nutrition. 3 Units.
This course will focus on understanding the nutritional needs of infants, children and adolescents. Evidence based guidelines will be used as we discuss best clinical practice for the management of pediatric nutrition issues. Anthropometric measurements used in growth assessment will be reviewed. Nutrient requirements for each stage of development will be explored with a specific focus on micronutrients relevant to pediatrics such as fluoride, iron, calcium and vitamin D. Abnormal growth resulting in malnutrition and obesity will be examined with a focus on prevention, diagnosis and treatment. Skills necessary to complete a pediatric nutrition assessment will be reviewed with opportunities to practice and demonstrate competency. Prereq: NTRN 435.

NTRN 437. Evaluation of Nutrition Information for Consumers. 3 Units.
Reading and appraisal of food and nutrition literature written for the general public, including books, magazines, newsletters. Prereq: Graduate standing and Nutrition or Public Health Nutrition major or consent of instructor.

NTRN 438. Dietary Supplements. 3 Units.
An examination of dietary supplements specific to health promotion and disease prevention/treatment throughout the life cycle. Topics and concepts include regulation, controversies, safety, efficacy, and the surrounding scientific evidence for dietary supplement use. Prereq: NTRN 364 or requisites not met permission.
NTRN 439. Food Behavior: Physiological, Psychological and Environmental Determinants. 3 Units.
Good dietary habits are associated with improved population health. Despite this, a large proportion of individuals do not meet current dietary recommendations and there are significant disparities between groups based on sociodemographic characteristics. Why is this? Traditional views on this question focused solely on individual decision making without taking into account the complex influence of biology, social forces, and environment on dietary behavior. This course will introduce students to the major influences on dietary behavior and their interactions and modifying factors in the context of the socioecological model.

NTRN 440. Nutrition for the Aging and Aged. 3 Units.
Consideration of the processes of aging and needs which continue throughout life. The influences of food availability, intake, economics, culture, physical and social conditions and chronic disease as they affect the ability of the aged to cope with living situations. Recommended preparation: Nutrition major or consent of instructor.

NTRN 446. Advanced Maternal Nutrition: Special Topics. 3 Units.
Analysis of the problems commonly associated with high-risk pregnancies and fetal outcome. Discussion of causes, mechanisms, management and current research. Recommended preparation: NTRN 435 or consent.

NTRN 448. Integrative and Functional Nutrition. 3 Units.
An examination of the core concepts and principles surrounding integrative and functional medical nutrition therapy (IFMNT). The course will emphasize a whole systems approach to addressing clinical imbalances and creating personalized therapeutic interventions based upon an individual's genetics, environment and lifestyle. Topics include precision medicine, IFMNT nutrition care plan processes, IFMNT laboratory tests and interpretation, dietary supplementation, and discussion of the evidence for integrative therapeutic nutrition/diet plans related to the gut microbiome/gastrointestinal disorders, food sensitivity/intolerance, methylation, immune function, detoxification, cardiometabolic intervention, energy, hormones, and wellness.

NTRN 451. Food Service Systems Management. 3 Units.
The application of organizational theory and skills in the preparation and service of quantity food. Laboratory experience in professional food services are included. Graduate students will analyze one aspect of food service management in depth. Offered as NTRN 351 and NTRN 451. Prereq: Nutrition major.

NTRN 452. Nutritional Biochemistry and Metabolism. 3 Units.
Mechanisms of regulation of pathways of intermediary metabolism; amplification of biochemical signals; substrate cycling and use of radioactive and stable isotopes to measure metabolic rates. Recommended preparation: BIOC 307 or equivalent. Offered as BIOC 452 and NTRN 452.

NTRN 454. Advanced Nutrition and Metabolism: Investigative Methods. 3 Units.
Lecture/discussion course on the use of analytical techniques in metabolic research on whole body metabolism, energy balance, and disease (diabetes, obesity, and neuropathologies); discussions include the design of in-vitro and in-vivo investigative protocols in humans and animals using stable isotope tracer and mass spectrometric analysis; critical interpretation of data from the literature with emphasis on metabolic pathway identification, regulation and kinetics. Recommended preparation: BIOC 407.

NTRN 455. Molecular Nutrition. 3 Units.
Students will gain in-depth understanding of the basic science and translational aspects of ‘hot topics’ in current molecular nutrition. Class will be conducted by interactive discussion of assigned primary research articles. Prereq: BIOC 407 or Requisites Not Met permission.

NTRN 459. Diabetes Prevention and Management. 3 Units.
In this course, we will explore the diabetes epidemic, its effects on the healthcare system, and strategies for prevention. The pathophysiology of the disease will be examined as well as environmental factors leading to the increase in diagnoses. Comorbid conditions and acute and chronic complications of diabetes and hyperglycemia will be addressed. Rationale for current therapeutic strategies will be explored, including the use of blood glucose monitoring, physical activity, nutrition counseling, oral medications, and insulin therapy. Patient education and health literacy will be studied in the context of patient centered goal setting. Requirements for developing a Diabetes Self-Management Education Program will be discussed. Community program development will be examined in the context of population-based prevention strategies. Offered as NTRN 359 and NTRN 459. Prereq: Graduate Standing.

NTRN 460. Sports Nutrition. 3 Units.
Study of the relationships of nutrition and food intake to body composition and human performance. Laboratory sessions include demonstrations of body composition and fitness measurements and participation in a research project. Recommended preparation: NTRN 363 or NTRN 433 or consent.

NTRN 461. Energy Dysregulation: From Obesity to Anorexia. 3 Units.
Energy imbalance and the implications on health will be explored in this course. Key concepts covered in this class include: 1. Energy imbalance refers to positive and negative states of energy balance and occurs when energy intake does not match energy expended in metabolic processes, daily living activities, and physical activity; 2. Obesity is a result of chronic positive energy balance whereas anorexia nervosa is a condition of chronic negative energy balance; 3. Energy metabolism is controlled by a complex array of neural and hormonal signaling; 4. Energy imbalance disrupts the neural and hormonal signaling pathways of energy metabolism resulting in unfavorable health consequences such as pro-inflammatory state, oxidative stress, immune dysregulation, menstrual dysfunction, sarcopenia, and low bone mineral density; and 5. Exercise training can impact energy imbalance health-related outcomes. Learning Outcomes: Students will be able to 1. define energy balance and explain the components of energy expenditure; 2. define disordered eating, female athlete triad, and disordered eating, 3. explain the relationship among energy intake, energy expenditure, and body composition in energy imbalance; 4. describe alterations in skeletal muscle and adipose physiology in energy imbalance; 5. diagram neural control of feeding and energy homeostasis and hormonal control of energy metabolism; 6. explain the neural and hormonal changes that occur in chronic energy imbalance and describe current theories in how it results in menstrual dysfunction, inflammatory response, oxidative stress, immune dysregulation, sarcopenia, and low bone mineral density; and 7. explain how exercise training can influence inflammatory response, oxidative stress, immune function, and musculoskeletal health in energy imbalance. Offered as NTRN 361 and NTRN 461. Prereq: NTRN 201 or requisites not met permission.
NTRN 462. Exercise Physiology and Macronutrient Metabolism. 3 Units.
The purpose of this course is to provide students with the knowledge of theoretical and applied concepts of exercise physiology. Students will gain an understanding of the acute and chronic physiological responses and adaptations of the cardiovascular, metabolic, hormonal, and neuromuscular systems in response to exercise. Additional topics include factors effecting performance, assessing cardiorespiratory and muscular fitness, designing exercise programs for health and wellness, special populations, and athletics, environmental considerations and nutrition’s role in sport and exercise performance. Offered as NTRN 362 and NTRN 462. Prereq: Nutrition Major.

NTRN 516. Seminar in Dietetics I. 4 Units.
Study of evidence-based guidelines for dietetic practice in medical nutrition therapy. Emphasis on life cycle stages and common disease states that require specialized nutrition care. Enrollment restricted to those accepted into Case Coordinated Dietetic Internship/Master Degree Program.

NTRN 517. Seminar in Dietetics II. 4 Units.
Study of scientific basis for clinical and community nutrition practice and developments in food service systems management. Recommended preparation: Dietetic internship.

NTRN 528. Introduction to Public Health Nutrition. 3 Units.
An introduction to the field of public health/community nutrition with a focus on three key themes: (1) The role of nutrition in population based health, (2) the multilevel nature of key influences on dietary behavior, and (3) skills needed to be a successful public health practitioner. Prereq: Graduate Student in Nutrition or Public Health Nutrition or Requisites Not Met permission.

NTRN 529. Nutritional Epidemiology. 3 Units.
This course uses epidemiology as a tool for assessing potential causal associations between dietary excesses, deficiencies and imbalances to the prevalent chronic diseases. It addresses the epidemiologic aspects of nutrition related chronic diseases, for example, the multi-factorial nature of etiology. Recommended preparation: Statistics and Public Health Nutrition students only.

NTRN 530. Public Health Nutrition. 3 Units.
Exploration of the professional role of the Public Health Dietitian/Nutritionist with a focus on three key themes: (1) The conduct of research and interpretation of research findings related to public health nutrition; (2) development of skills in the domains of public health management, program design and implementation, and communications and marketing; and (3) approaches to thinking about public health more broadly through the use of entrepreneurship and community building. Prereq: Graduate Student in Nutrition or Public Health Nutrition or Requisites Not Met permission.

NTRN 531. Public Health Nutrition Field Experience. 1 - 6 Units.
Individually planned public health experience. May be concurrent with course work in local agencies or in blocks of full-time work with a city, county, or state health agency. Prereq: Open to public health nutrition students only. Consent of instructor.

NTRN 532C. Specialized Public Health Nutrition Field Experience. 1 - 3 Units.
Individually arranged clinical experience. Prereq: Public Health Nutrition students only. Consent of instructor.

NTRN 533. Nutritional Care of Neonate. 3 Units.
Nutritional assessment and management of high-risk newborns with emphasis on prematurity and low birth weight. Review of current literature coordinated with clinical experience in the neonatal intensive care unit. Issues on follow-up included. Recommended preparation: NTRN 435 or consent.

NTRN 534. Advanced Public Health Nutrition Field Experience. 1 - 6 Units.
Individually planned advanced public health experience. Prereq: Open to public health nutrition students only.

NTRN 550A. Advanced Community Nutrition. 3 Units.
An introduction to the field of public health/community nutrition with a focus on three key themes: (1) The role of nutrition in population based health, (2) the multilevel nature of key influences on dietary behavior, and (3) skills needed to be a successful public health practitioner. Prereq: Senior Nutrition major or Requisites Not Met permission.

NTRN 551. Seminar in Advanced Nutrition. 1 Unit.
Ph.D. students meet weekly to discuss topical journal articles. Students gain experience in critical evaluation of research and develop presentation/communication skills. Discussion of research integrity and ethics. Students participate in departmental seminars with invited speakers.

NTRN 561. Investigative Methods in Nutrition. 1 - 4 Units.
Research methods appropriate for nutrition. Methods for conducting research in nutrition and food sciences, food service management and dietetics. Designing research proposals. Prereq: Nutrition major.

NTRN 562. Research Practicum. 1 - 3 Units.
Students will participate in nutrition-related research activities that employ a variety of research methodologies (clinical research, bench science, surveys, systematic reviews, etc.). Students will be engaged in the acquisition of scientific data, and data entry, analysis and interpretation.

NTRN 601. Special Problems. 1 - 18 Units.
NTRN 602. Special Project in Nutrition. 1 - 3 Units.
Under the supervision of the instructor, the student will develop and/or implement an individual or group special project in global nutrition, community nutrition, wellness, or other area of food and nutrition practice. Prereq: Graduate Standing.

NTRN 610. Oxygen and Physiological Function. 3 Units.
Lecture/discussion course which explores the significance and consequences of oxygen and oxygen metabolism in living organisms. Topics to be covered include oxygen transport by blood tissues, oxygen toxicity, and mitochondrial metabolism. Emphasis will be placed on mammalian physiology with special reference to brain oxidative metabolism and blood flow as well as whole body energy expenditure and oxidative stress related to disease. The course will cover additional spans of physiology, nutrition and anatomy. Offered as ANAT 610, NTRN 610, and PHOL 610.

NTRN 651. Thesis M.S.. 1 - 18 Units.
NTRN 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Pathology
Wolstein Research Building 5537
http://www.case.edu/med/pathology/
Phone: 216.368.1993; Fax: 216.368.0494
Masters Degrees

MS in Pathology (full-time)

The full-time Master's Program in Pathology is intended for students with a background in the biological or chemical sciences, typically a bachelors or baccalaureate degree, who are interested in pursuing advanced coursework in the basis of disease. This coursework may be useful for those interested in pursuing a professional doctoral degree (e.g., MD, DO, DDS, or DMD) or other health professions degree, since the core curriculum and electives include many topics of medical relevance, including histology, gross anatomy, pathology, cancer and immunology. The time of matriculation in the Program is flexible; a typical time to degree is anticipated to be 4 semesters, although completion in approximately 13 months, including an intensive summer course in Anatomy, is possible. The course of study will be determined by the student, their Academic advisor, and the Graduate Program Committee and will consist of 30 credit hours of course work. Flexible electives in cellular basis of disease, immunology and cancer biology will allow students to focus on an area of interest. Graduates of the Program can pursue opportunities in basic or clinical research, teaching, biotechnology, pharmaceuticals, health care, or government. While the Master's may be a terminal degree, it may also lead to admission to professional or PhD programs. For information on the Pathology M.S. Program, please contact Pamela Warsch, Ph.D., paw28@case.edu/216.368.5059, or Christy Kehoe, cxx15@case.edu/216.368.1993.

Description of Program

Students will earn a Plan B Masters from Case Western Reserve University. The degree program is comprised of core courses in Pathology with elective course work from related disciplines, a course on research ethics, attendance of the departmental seminar series, and a comprehensive final project in the form of a review paper that will ideally be suitable for publication. The topic of the review paper will be determined by the student and their academic advisor. The core of the Program is geared toward providing the student a solid basis in cell biology and pathology. This begins with courses in histology and cell & molecular biology (ANAT 412 Histology and Ultrastructure/ANAT 413 General Histology Laboratory and PATH 475 Cell and Molecular Foundations of Pathology) followed by courses in basic pathology and immunology (PATH 510 Basic Pathologic Mechanisms and PATH 416 Fundamental Immunology). After the first year the student can specialize by choosing electives in their area of interest. In the final semester the student will register for 3 credits of PATH 650 Independent Study while writing their paper. An advisor for the paper should be identified by mutual interest during the first year.

Typical Curriculum

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<tr>
<th>First Year</th>
<th>Summer</th>
<th>Fall</th>
<th>Spring</th>
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<tr>
<td>Cadaver dissection-based human anatomy with histology and physiologic correlations (ANAT 410)</td>
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<tr>
<td>Cell Biology of Neurodegenerative Disorders (PATH 524)</td>
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<tr>
<td>Attendance optional in summer semester</td>
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<tr>
<td>Students may apply to laboratories to do research projects in related fields (e.g. cancer, immunology, neuropathology)</td>
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<td>Pre-professional students may wish to spend time on school applications</td>
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<tr>
<td>Histology and Ultrastructure &amp; General Histology Laboratory (ANAT 412)</td>
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<td>Cell and Molecular Foundations of Pathology (PATH 475)</td>
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<td>Experimental Pathology Seminar I (PATH 511)</td>
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<td>Independent Study (PATH 650)</td>
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<td>Basic Pathologic Mechanisms (PATH 510)</td>
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<td>Fundamental Immunology (PATH 416)</td>
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<td>On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)</td>
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<tr>
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<td>Experimental Pathology Seminar I (PATH 511)</td>
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<tr>
<td>Electives:</td>
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<tr>
<td>Oxidative Stress and Disease Pathogenesis (PATH 430)</td>
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<tr>
<td>Advanced Immunobiology (PATH 465)</td>
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<td>Immunology of Infectious Diseases (PATH 481)</td>
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<td>Yeast Genetics and Cell Biology (PATH 488)</td>
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<td>Protein Misfolding and Human Disease: Molecular Basis and Clinical Implications (PATH 525)</td>
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<td>Other electives upon approval</td>
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<td>Cytoskeleton and Disease (PATH 415)</td>
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<td>Current Topics in Vision Research (PATH 432)</td>
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<td>Neurodegenerative Diseases: Pathological, Cellular, &amp; Molecular Perspectives (PATH 444)</td>
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<td>Introduction to Microarrays (PATH 460)</td>
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**Total Units in Sequence:** 47-85

### Accelerated Curriculum

#### First Year

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**Total Units in Sequence:** 28-44

* Students with a significant background in Cell and Molecular Biology may take Path 525 (Transport and targeting of macromolecules in health and disease) or Path 488 (Yeast Genetics and Cell Biology) instead.

### Admission Criteria

Applicants will be screened by the Pathology Department Admissions Committee. Students will be required to supply a GRE or MCAT score, a transcript, three letters of recommendation and an application essay that details the student's interest in the Program. Students will be interviewed on campus of via electronic media (i.e. FaceTime or Skype). Although there are no set requirements, successful applicants would be expected to have an MCAT >26, GRE verbal >150 and GRE quantitative > 150, and an undergraduate GPA around 3.0. Applications will be accepted
throughout the year with a deadline of June 1st; final decisions for Fall matriculation will be made by July 1st. Prospective students are advised to submit their applications well in advance of the deadline, since the class may fill completely before that date.

Tuition

Financial aid will not be provided by the Department. Students may apply for financial aid through the federal government at http://www.fafsa.ed.gov/. Tuition for the 2017-2018 academic year is $1827/credit hour. Tuition increases each academic year by approximately 4%. The total cost of the Program is based on tuition for the credits taken each term.

**MS in Pathology (part-time)**

A part-time program leading to the Master of Science degree in Pathology is available to laboratory staff who are employed by Case Western Reserve University. Students in this program must be full-time university employees and must have the agreement of their supervisor to begin studies as a part-time student. Courses are available as an employee fringe benefit (up to 6 credits per semester for Fall and Spring, and 3 credits for Summer) and can only be taken as limited by the fringe benefit regulations.

A formal application for this program must be submitted to the graduate school. Prior to submission of this application, the employee, the supervisor, and the Director of the Pathology Graduate Program must meet to review and facilitate the student's application for admission.

This program can lead to an M.S. degree through Plan A. Required core courses include CBIO 453 Cell Biology I (4 credits), CBIO 455 Molecular Biology I (4 credits), PATH 510 Basic Pathologic Mechanisms (4 credits), and participation in a seminar course (PATH 511 Experimental Pathology Seminar I and/or PATH 512 Experimental Pathology Seminar II) for at least one semester. CBIO 453 Cell Biology I, CBIO 455 Molecular Biology I and must be taken as graded courses (not P/F).

Plan A requires a minimum of 27 total coursework credits. In addition to the required core courses, the student must take a minimum of 6 credits of PATH 651 Thesis, which involves research in the laboratory of the supervisor (who serves as the M.S. Thesis Mentor) and thesis preparation. The student must register for at least one credit of PATH 651 Thesis M.S. every semester until graduation. A GPA of 2.75 or better must be maintained for a terminal M.S. (Students considering using the M.S. in Pathology as a "stepping stone" to the Ph.D. degree must maintain a GPA of 3.0 or better.) An M.S. thesis must be prepared based on the research, and the student must pass an M.S. Degree Examination in which the thesis is defended.

**MD/MS Biomedical Investigation--Pathology Track**

For Program Admissions and MD requirements, see MD Dual Degree Programs (p. 724). This track is designed to provide students with an in-depth understanding of the cellular basis of disease or immunity. During the first year of medical school the student should identify a mentor and begin planning coursework and a research project leading to the MS degree. Because the background and interest of applicants varies widely, members of the Program Oversight Committee will assist each student in designing an individualized schedule of graduate courses for any track.

Students are expected to complete at least two graduate courses (3 credits each or total 6 credits) before beginning the laboratory research period (year 3), and students should take three graduate courses before the research period if this is possible. For students to receive graduate credit for any medical coursework (as IBIS credit, e.g. IBIS 403 Integrated Biological Sciences III), they must register at the beginning of the semester. Students in the MD/MS joint degree program must attain a cumulative GPA of 3.0 in the graduate courses. Students in this program may participate in any of the three tracks of the Department of Pathology Graduate Program.

For information about the Pathology Track in the MD/MS program, contact Christy Kehoe, 216.368.1993, or Dr. Clive Hamlin (clive.hamlin@case.edu), 216.368.0512.

**Students in the Pathology track must complete:**

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<tr>
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<th>Course Title</th>
<th>Units</th>
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<tr>
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<td>or PATH 512</td>
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<td>IBIS 600</td>
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**And 9 credits from the Pathology courses listed below or other Approved courses.** Other department’s graduate level course may be accepted provided it is appropriate to the student’s project and is approved by his/her Thesis Committee or the Graduate Program Director in Pathology.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>PATH 410</td>
<td>Aging and the Nervous System</td>
<td>1</td>
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<tr>
<td>PATH 415</td>
<td>Cytoskeleton and Disease</td>
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<tr>
<td>PATH 416</td>
<td>Fundamental Immunology</td>
<td>4</td>
</tr>
<tr>
<td>PATH 417</td>
<td>Cytokines: Function, Structure, and Signaling</td>
<td>3</td>
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<tr>
<td>PATH 430</td>
<td>Oxidative Stress and Disease Pathogenesis</td>
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<td>PATH 432</td>
<td>Current Topics in Vision Research</td>
<td>3</td>
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<tr>
<td>PATH 444</td>
<td>Neurodegenerative Diseases: Pathological, Cell &amp; Molecular Perspectives</td>
<td>3</td>
</tr>
<tr>
<td>PATH 480</td>
<td>Logical Dissection of Biomedical Investigations</td>
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<tr>
<td>PATH 481</td>
<td>Immunology of Infectious Diseases</td>
<td>3</td>
</tr>
<tr>
<td>PATH 488</td>
<td>Yeast Genetics and Cell Biology</td>
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<tr>
<td>PATH 510</td>
<td>Basic Pathologic Mechanisms</td>
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<tr>
<td>PATH 525</td>
<td>Protein Misfolding and Human Disease: Molecular Basis and Clinical Implications</td>
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**Example Plan of Study of Minimum Coursework:**

**First Year**

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<th>Summer</th>
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**Second Year**

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<td>Graduate Course*</td>
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PhD in Pathology

PhD Training in the Pathology Graduate Program occurs in three tracks that share a common core curriculum but provide additional track-specific curricular offerings. This provides a cohesive program that addresses the specific needs of different Pathology-related areas of research training. Section II of the handbook “Pathology PhD Program” describes core features of the program that are shared and provides detailed descriptions of the three training tracks:

- Molecular and Cellular Basis of Disease Training Program (MCBTP)
- Immunology Training Program (ITP)
- Cancer Biology Training Program (CBTP)

To earn a PhD in Pathology, a student must complete rotations in at least three laboratories followed by selection of a research advisor, and complete Core and Elective coursework including responsible conduct of research as described in the Course of Study, below. Students who previously completed relevant coursework, (for example, with a MS) may petition to complete alternative courses. Each training track follows the overall regulations established and described in CWRU Graduate Studies and documented to the Regents of the State of Ohio. Completion of the PhD degree will require 36 hours of coursework (24 hours of which are graded) and 18 hours of PATH 701 Dissertation Ph.D..

In addition, each PhD student must successfully complete a qualifier examination for advancement to candidacy in the form of a short grant proposal with oral defense. The qualifier is generally completed in the summer after year two. During the dissertation period, students are expected to meet twice a year with the thesis committee, present seminars in the department, and fulfill journal publication requirements. Throughout the doctoral training, students are expected to be enthusiastic participants in seminars, journal clubs, and research meetings in the lab and program.

§ Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045)

Molecular and Cellular Basis of Disease Training Program (MCBTP)

First Year

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Please also see Graduate Studies Academic Requirements for Doctoral Degrees (p. 1045)
### Third Year

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**Total Units in Sequence:** 43-126

* Alternate courses for MSTP students: IBIS 401-404. MSTP students in the MCBDTP do not need to take CBIO 453 Cell Biology I, CBIO 455 Molecular Biology I, PATH 510 Basic Pathologic Mechanisms or PATH 416 Fundamental Immunology although PATH 416 Fundamental Immunology may still be taken as a Track Elective

^ Alternate course is MSTP 400 Research Rotation in Medical Scientist Training Program for MSTP students and PATH 601 Special Problems for direct admit students

### Immunology Training Program (ITP)

#### First Year

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<th>Units</th>
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<td>Molecular Biology I (CBIO 455)</td>
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<tr>
<td>Immunology Journal Club (optional this semester)</td>
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<td>Mentor and Track chosen</td>
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<td>Basic Pathologic Mechanisms (PATH 510)</td>
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### Second Year

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<th>Summer</th>
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<td>Immunology Journal Club (required this semester)</td>
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### Third Year

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<tr>
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<td>Dissertation Ph.D. (PATH 701)**</td>
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<tr>
<td>Immunology Journal Club (required this semester)</td>
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<td>Experimental Pathology Seminar II (PATH 512)</td>
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<td>Dissertation Ph.D. (PATH 701)**</td>
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### Fourth Year

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<tr>
<td>Dissertation Ph.D. (PATH 701)**</td>
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* Alternate course for MSTP students: IBIS 401-404. MSTP students in the MCBDTP do not need to take CBIO 453 Cell Biology I, CBIO 455 Molecular Biology I, PATH 510 Basic Pathologic Mechanisms or PATH 416 Fundamental Immunology although PATH 416 Fundamental Immunology may still be taken as a Track Elective

^ Alternate course is MSTP 400 Research Rotation in Medical Scientist Training Program for MSTP students and PATH 601 Special Problems for direct admit students
Immunology Journal Club (required this semester) 1
Experimental Pathology Seminar II (PATH 512) 1
Dissertation Ph.D. (PATH 701)** 1-9
Immunology Journal Club (required this semester)
Year Total: 2-10 2-10

Fifth Year

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
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<td>Experimental Pathology Seminar II (PATH 512)</td>
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<td>Dissertation Ph.D. (PATH 701)***</td>
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Total Units in Sequence: 44-127

* Alternate courses for MSTP students: IBIS 401-404. MSTP students in the ITP do not need to take CBIO 453 Cell Biology I, CBIO 455 Molecular Biology I or PATH 510 Basic Pathologic Mechanisms. PATH 416 Fundamental Immunology is required for MSTP students in the ITP unless they have sufficient prior immunology background as determined by the ITP Chair and curriculum coordinators (e.g. Drs. Harding and Nedrud)

^ Alternate course is MSTP 400 Research Rotation in Medical Scientist Training Program for MSTP students and PATH 601 Special Problems for direct admit students.

** PATH 520 Basic Cancer Biology and the Interface with Clinical Oncology + PATH 521 Special Topics in Cancer Biology and Clinical Oncology is included as a Track Elective for ITP students

Cancer Biology Training Program (CBTP)

First Year

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<th>Summer</th>
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<td>Basic Pathologic Mechanisms (PATH 510)</td>
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<tr>
<td>Basic Cancer Biology and the Interface with Clinical Oncology (PATH 520)</td>
<td>3</td>
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<tr>
<td>Special Topics in Cancer Biology and Clinical Oncology (PATH 521)</td>
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<tr>
<td>On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)</td>
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Experimental Pathology Seminar I (PATH 511) 1
Dissertation Ph.D. (PATH 701)** 1-9
Thesis commite chosen: preproposal committee meeting scheduled
Year Total: 6-15 11-19

Second Year

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Third Year

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Fourth Year

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Fifth Year

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Courses

PATH 316. Fundamental Immunology. 4 Units.

Introductory immunology providing an overview of the immune system, including activation, effector mechanisms, and regulation. Topics include antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity, innate versus adaptive immunity, cytokines, and basic molecular biology and signal transduction in B and T lymphocytes, and immunopathology. Three weekly lectures emphasize experimental findings leading to the concepts of modern immunology. An additional recitation hour is required to integrate the core material with experimental data and known immune mediated diseases. Five mandatory 90 minute group problem sets per semester will be administered outside of lecture and recitation meeting times. Graduate students will be graded separately from undergraduates, and 22 percent of the grade will be based on a critical analysis of a recently published, landmark scientific article. Offered as BIOL 316, BIOL 416, CLBY 416, PATH 316 and PATH 416. Prereq: BIOL 215 and BIOL 215L.
PATH 390. Undergraduate Research in Cancer Biology, Immunology, or Pathology. 1 - 3 Units.
Students undertake a research project directly related to ongoing research in the investigator’s/instructor’s laboratory. Written proposal outlining research topic, a schedule of meetings and format and length of final written report to be prepared prior to registration for credit. Recommended preparation: One year of college chemistry and consent of instructor.

PATH 405. Discussions in Molecular Immunology (Health and Disease). 2 Units.
Targeted student population would be undergraduate (Biology major), PhD, MD, or MD/PhD students interested in emerging research on the mechanisms of molecular immunology and effects on health and defects in disease. Readings will be assigned, and students will come to class prepared for discussions. P/NP grades will be based on these discussions. 5 or fewer students will be selected for this class. Prereq: Undergraduate Biology majors, PhD, MD, or MD/PhD students.

PATH 406. Basic Cancer Biology and the Interface with Clinical Oncology. 3 Units.
This is a graduate-level introductory course in cancer biology taught through the Departments of Pharmacology and Pathology. This course will give students a broad overview of current basic cancer biology, highlight recent advances in cancer therapeutics, and provide a clinical perspective of the pathogenesis and treatment of common cancers. Classes will be of lecture and discussion format, and will also include student discussion of journal research articles to develop critical thinking in cancer research and experimental design as well as presentation/communication skills. About 1 to 3 students per class will be scheduled to lead the presentation and discussion of the selected journal articles. However, all students will be required to read the material in advance and be ready for discussion. Topics will cover growth factor action and signal transduction, oncogenes, tumor suppressor genes, DNA damage, apoptosis, cancer immunology, cancer stem cells, metastasis, angiogenesis, chemotherapy, radiation therapy, targeted therapeutics, photodynamic therapy, targeting cancer stem cells, chemoprevention, and clinical aspects of cancers of the breast, prostate, lymphatic tissue, and colon. Course grades for PHRM/PATH 520 (Ph.D. track): will be determined by class participation/presentation (40%), an original research grant proposal (35%) and written and oral critiques of two research proposals (25%). Course grades for PHRM/PATH 406 (M.S. and non-degree track): will be determined by class participation/presentation (40%), a literature review term paper (35%) and oral defense of term paper with course directors (25%). Presentations/Participation: Instructors will complete a standardized evaluation form to provide you uniform feedback in a timely manner. Required Reading: Assigned reviews, original articles (in blackboard) Recommended Reading: The Biology of Cancer (2nd Edition), by Robert A. Weinberg Garland Science, copyright 2014 Recommended Preparation: A course in Cell Biology. A course in Molecular Biology. Offered as PATH 406, PATH 520, PHRM 406 and PHRM 520.

PATH 410. Aging and the Nervous System. 1 Unit.
Lectures and discussion on aspects of neurobiology of aging in model systems; current research on Alzheimer’s, Parkinson’s, and Huntington’s diseases.

PATH 415. Cytoskeleton and Disease. 1 Unit.
Discussion of recent papers that have added to knowledge of normal cytoskeletal functions and their alterations in disease.

PATH 416. Fundamental Immunology. 4 Units.
Introductory immunology providing an overview of the immune system, including activation, effector mechanisms, and regulation. Topics include antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity, innate versus adaptive immunity, cytokines, and basic molecular biology and signal transduction in B and T lymphocytes, and immunopathology. Three weekly lectures emphasize experimental findings leading to the concepts of modern immunology. An additional recitation hour is required to integrate the core material with experimental data and known immune mediated diseases. Five mandatory 90 minute group problem sets per semester will be administered outside of lecture and recitation meeting times. Graduate students will be graded separately from undergraduates, and 22 percent of the grade will be based on a critical analysis of a recently published, landmark scientific article. Offered as BIOL 316, BIOL 416, CLBY 416, PATH 316 and PATH 416. Prereq: Graduate standing and consent of instructor.

PATH 417. Cytokines: Function, Structure, and Signaling. 3 Units.
Regulation of immune responses and differentiation of leukocytes is modulated by proteins (cytokines) secreted and/or expressed by both immune and non-immune cells. Course examines the function, expression, gene organization, structure, receptors, and intracellular signaling of cytokines. Topic include regulatory and inflammatory cytokines, colony stimulating factors, chemokines, cytokine and cytokine receptor gene families, intracellular signaling through STAT proteins and tyrosine phosphorylation, clinical potential, and genetic defects. Lecture format using texts, scientific reviews and research articles. Recommended preparation: PATH 416 or equivalent. Offered as BIOL 417, CLBY 417, and PATH 417.

PATH 418. Tumor Immunology. 3 Units.
Interactions between the immune system and tumor cells. Topics include the historical definition of tumor specific transplantation antigens, immune responses against tumor cells, the effects of tumor cell products on host immune responses, molecular identification of tumor specific transplantation antigens and recent advances in the immunotherapy of human cancers. Prereq: PATH 416.

PATH 420. Topics in Evolution and Medicine. 3 Units.
The course will be based primarily on the textbook, as well as additional readings to supplement this lucide but relatively brief introduction to the field. Topics to be covered include the overview of the relevance of evolution to medicine; human demography, history and disease; basic and evolutionary genetics; cystic fibrosis; life history trade-offs and the evolutionary biology of aging; cancer; host-pathogen interactions and co-evolution; somatic cell mutation, selection, and evolution in health and disease (not in textbook); sexually transmitted diseases; malaria; gene culture co-evolution; and man-made diseases. Recommended Preparation: Undergraduate knowledge of genetics, biochemistry, cell biology, microbiology, and immunology is advisable. Prior consultation and permission from the Course Director is strongly advised.
PATH 422. Current Topics in Cancer. 3 Units.
The concept of cancer hallmarks has provided a useful guiding principle in our understanding of the complexity of cancer. The hallmarks include sustaining proliferative signaling, evading growth suppressors, enabling replicative immortality, activating invasion and metastasis, inducing angiogenesis, resisting cell death, deregulating cellular energetics, avoiding immune destruction, tumor-promoting inflammation, and genome instability and mutation. The objectives of this course are to (1) examine the principles of some of these hallmarks, and (2) explore potential therapies developed based on these hallmarks of cancer. This is a student-driven and discussion-based graduate course. Students should have had some background on the related subjects and have read scientific papers in their prior coursework. Students will be called on to present and discuss experimental design, data and conclusions from assigned publications. There will be no exams or comprehensive papers but students will submit a one-page critique (strengths and weaknesses) of one of the assigned papers prior to each class meeting. The course will end with a full-day student-run symposium on topics to be decided jointly by students and the course director. Grades will be based on class participation, written critiques, and symposium presentations. Offered as BIOC 420, MBIO 420, PATH 422, and PHRM 420. Prereq: CBIO 453 and CBIO 455.

PATH 430. Oxidative Stress and Disease Pathogenesis. 1 Unit.
Oxidative stress and free radicals are implicated in a number of disease processes including aging, arthritis, emphysema, Alzheimer's disease and cancer. Lecture course with discussion of recent studies concerning the formation and destructive mechanisms of free radicals in the context of various disease processes. Students read assigned papers and discuss these in class.

PATH 432. Current Topics in Vision Research. 3 Units.
Vision research is an exciting and multidisciplinary area that draws on the disciplines of biochemistry, genetics, molecular biology, structural biology, neuroscience, and pathology. This graduate level course will provide the student with broad exposure to the most recent and relevant research currently being conducted in the field. Topics will cover a variety of diseases and fundamental biological processes occurring in the eye. Regions of the eye that will be discussed include the cornea, lens, and retina. Vision disorders discussed include age-related macular degeneration, retinal ciliopathies, and diabetic retinopathy. Instructors in the course are experts in their field and are members of the multidisciplinary visual sciences research community here at Case Western Reserve University. Students will be exposed to the experimental approaches and instrumentation currently being used in the laboratory and in clinical settings. Topics will be covered by traditional lectures, demonstrations in the laboratory and the clinic, and journal club presentations. Students will be graded on their performance in journal club presentations (40%), research proposal (40%), and class participation (20%). Offered as NEUR 432, PATH 432, PHRM 432 and BIOC 432.

PATH 444. Neurodegenerative Diseases: Pathological, Cell, & Molecular Perspectives. 3 Units.
This course, taught by several faculty members, encompasses the full range of factors that contribute to the development of neurodegeneration. Subjects include pathological aspects, neurodegeneration, genetic aspects, protein conformation and cell biology in conditions such as Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis and prion diseases. Students read assigned primary literature and present and discuss these in class.

PATH 450. Interdisciplinary Musculoskeletal Research: Selected Topics and Grant Writing Workshop. 3 Units.
This is an introductory graduate course in MSK research topics, grant writing, and reviewing skills. During this course, each student will be introduced to diverse multidisciplinary topics in MSK research and will write a research grant on a MSK topic of his/her choice that is not regurgitation of their mentor's grant. Students will also participate in editing and reviewing the proposals of their classmates. Proposals can form the basis of fellowship applications (F30/F31). For predocs, your department/program may allow the proposal to form the basis for the written component of your preliminary examination. Recommended Preparation: Current engagement in musculoskeletal research.

PATH 460. Introduction to Microarrays. 3 Units.
Microarray technology is an exciting new technique that is used to analyze gene expression in a wide variety of organisms. The goal of this course is to give participants a hands-on introduction to this technology. The course is intended for individuals who are preparing to use this technique, including students, fellows, and other investigators. This is a hands-on computer-based course, which will enable participants to conduct meaningful analyses of microarray data. Participants will gain an understanding of the principles underlying microarray technologies, including: theory of sample preparation, sample processing on microarrays, familiarity with the use of Affymetrix Microarray Suite software and generation of data sets. Transferring data among software packages to manipulate data will also be discussed. Importation of data into other software (GeneSpring and DecisionSite) will enable participants to mine the data for higher-order patterns. Participants will learn about the rationale behind the choice of normalization and data filtering strategies, distance metrics, use of appropriate clustering choices such as K-means, Hierarchical, and Self Organizing Maps. Offered as BIOC 460, PATH 460 and CNCR 460.

PATH 465. Advanced Immunobiology. 4 Units.
This course will cover fundamental (innate and adaptive responses, antigen recognition, cell activation, etc.) and applied (immune evasion, autoimmunity, allergy, transplantation, vaccines, etc.) immunology topics, highlighting the most important and recent advancements found in the primary literature. Lectures will be derived largely from the primary literature, but will also include modern techniques and fundamental background knowledge to enhance the learning environment for the immunology concepts presented. Course organization consists of two lectures per week by the immunology faculty, midterm and final examinations, and an oral presentation. Enrolled students have the option of concurrent enrollment in PATH 466 Writing for Immunologists. Prereq: PATH 416

PATH 466. Proposal Writing for Immunologists. 1 Unit.
This course is an introduction to research proposal writing and evaluation for immunology graduate students. One of the most important aspects of being an active investigator in academia, biotechnology, or pharmaceutical industries is being a skilled communicator of one's ideas. This course is designed to teach these practical writing skills and will include lectures and discussions of key writing strategies. Throughout the semester, students will write a research proposal on a topic outside of their thesis research focus (but it can be related), present their ideas in front of the class, and take part in an end-of-semester review panel of the proposals of their classmates. Enrollment requires concurrent enrollment in PATH 465 Advanced Immunobiology and instructor permission. Prereq: PATH 416. Coreq: PATH 465.
PATH 475. Cell and Molecular Foundations of Pathology. 3 Units.
This course is designed for M.S. students in the Pathology Graduate Program, and is an introductory course covering normal cell and molecular biology as well as cell physiology. Additional topics to be discussed in the course will include cell structure and function, as well as correlates to cellular and molecular pathology. Recommended Preparation: Should have undergrad-level cell biology and biochemistry.

PATH 480. Logical Dissection of Biomedical Investigations. 3 Units.
PATH 480 is an upper level graduate course encompassing discussion and critical appraisal of both published and pre-published research papers, book chapters, commentaries and review articles. Emphasis will be placed on evaluating the logical relationships connecting hypotheses to experimental design and experimental data to conclusions drawn. Thus, the course will aim to develop students’ capacities for independent thinking and critical analysis. Half of the course will be devoted to an analysis of fundamental conceptual issues pertaining to immunology, but this material will be applicable to a wide variety of fields. The other half of the course will be devoted to the analysis of papers that have been submitted for publication (with the students acting as primary reviewers of these papers). Our expectation is that this course will have practical relevance for students by providing them with methods to review their own prepublication manuscripts and eliminate common errors. It should also give students the tools to question widely held beliefs in diverse biomedical fields. Recommended preparation is completion of the C3MB curriculum and 2nd year or higher graduate school training. Previous exposure to immunology and molecular biology will be helpful but not required.

PATH 481. Immunology of Infectious Diseases. 3 Units.
This course centers on mechanisms of immune defense, immune escape and disease pathogenesis caused by important human pathogens. Some of the infectious diseases covered in this course include AIDS, TB and Malaria. Most topics focus on immunology of viral, bacterial, protozoan and fungal infections. Topics will also include aspects of epidemiology and global health. Classes will consist of literature review of current scientific articles, faculty lectures and student presentations. Grades will be determined by exams, class presentations, participation, and short reports. Graduate students will also be asked to write a brief research proposal. PATH 481 involves faculty from: Division of Infectious Diseases and HIV Medicine, Center for Global Health & Diseases, Department of Pathology. Prereq: PATH 416.

PATH 488. Yeast Genetics and Cell Biology. 3 Units.
This seminar course provides an introduction to the genetics and molecular biology of the yeasts S. cerevisiae and S. pombe by a discussion of current literature focusing primarily on topics in yeast cell biology. Students are first introduced to the tools of molecular genetics and special features of yeasts that make them important model eukaryotic organisms. Some selected topics include cell polarity, cell cycle, secretory pathways, vesicular and nuclear/cytoplasmic transport, mitochondrial import and biogenesis, chromosome segregation, cytoskeleton, mating response and signal transduction. Offered as CLBY 488, GENE 488, MBIO 488, and PATH 488.

PATH 510. Basic Pathologic Mechanisms. 4 Units.
An interdisciplinary introduction to the fundamental principles of molecular and cellular biology as they relate to the pathologic basis of disease. Lectures, laboratories, conferences.

PATH 511. Experimental Pathology Seminar I. 1 Unit.
Weekly discussions of current topics and research by students, staff and distinguished visitors.

PATH 512. Experimental Pathology Seminar II. 1 Unit.
Weekly discussions of current topics and research by students, staff and distinguished visitors.

PATH 520. Basic Cancer Biology and the Interface with Clinical Oncology. 3 Units.
This is a graduate-level introductory course in cancer biology taught through the Departments of Pharmacology and Pathology. This course will give students a broad overview of current basic cancer biology, highlight recent advances in cancer therapeutics, and provide a clinical perspective of the pathogenesis and treatment of common cancers. Classes will be of lecture and discussion format, and will also include student discussion of journal research articles to develop critical thinking in cancer research and experimental design as well as presentation/communication skills. About 1 to 3 students per class will be scheduled to lead the presentation and discussion of the selected journal articles. However, all students will be required to read the material in advance and be ready for discussion. Topics will cover growth factor action and signal transduction, oncogenes, tumor suppressor genes, DNA damage, apoptosis, cancer immunology, cancer stem cells, metastasis, angiogenesis, chemotherapy, radiation therapy, targeted therapeutics, photodynamic therapy, targeting cancer stem cells, chemoprevention, and clinical aspects of cancers of the breast, prostate, lymphatic tissue, and colon. Course grades for PHRM/PATH 520 (Ph.D. track): will be determined by class participation/presentation (40%), an original research grant proposal (35%) and written and oral critiques of two research proposals (25%). Course grades for PHRM/PATH 406 (M.S. and non-degree track): will be determined by class participation/presentation (40%), a literature review term paper (35%) and oral defense of term paper with course directors (25%). Presentations/Participation: Instructors will complete a standardized evaluation form to provide you uniform feedback in a timely manner. Required Reading: Assigned reviews, original articles (in blackboard) Recommended Reading: The Biology of Cancer (2nd Edition), by Robert A. Weinberg Garland Science, copyright 2014 Recommended Preparation: A course in Cell Biology. A course in Molecular Biology. Offered as PATH 406, PATH 520, PHRM 406 and PHRM 520.

PATH 521. Special Topics in Cancer Biology and Clinical Oncology. 1 Unit.
This one credit hour course in Cancer Biology is intended to give students an opportunity to do independent literature research while enrolled in PHRM 520/PATH 520. Students must attend weekly Hematology/Oncology seminar series and write a brief summary of each of the lectures attended. In addition, students must select one of the seminar topics to write a term paper which fully reviews the background related to the topic and scientific and clinical advances in that field. This term paper must also focus of Clinical Oncology, have a translational research component, and integrate with concepts learned in PHRM 520/PATH 520. Pharmacology students must provide a strong discussion on Therapeutics, while Pathology students must provide a strong component on Pathophysiology of the disease. Recommended preparation: CBIO 453 and CBIO 455, or concurrent enrollment in PHRM 520 or PATH 520. Offered as PATH 521 and PHRM 521.

PATH 523. Histopathology of Organ Systems. 3 Units.
Comprehensive course covering the underlying basic mechanisms of injury and cell death, inflammation, immunity, infection, and neoplasia followed by pathology of specific organ systems. Material will include histological (‘structure’) and physiological (‘function’) aspects related to pathology (human emphasis). Recommended preparation: ANAT 412 or permission of instructor. Offered as ANAT 523 and PATH 523.
PATH 524. Cell Biology of Neurodegenerative Disorders. 3 Units.
PATH 524 is a 3 credit hour introductory course on neurodegenerative disorders intended for Master's and first and second-year medical students. This course attempts to bridge the gap between molecular mechanisms at the cellular level with disease presentation and therapeutic options for neurodegenerative disorders of protein misfolding and metal mis-metabolism. The course will cover topics related to Alzheimer’s disease, Parkinson’s disease, Huntington’s disease, Amyotrophic lateral sclerosis, Multiple sclerosis, Prion diseases, disorders of iron and copper metabolism, and other disorders of interest to the students. The class will meet once every week, and following an introductory lecture, the students will discuss relevant scientific reports from recent literature. Students are expected to participate actively in class discussion, and write a 5-6 page research proposal following NIH guidelines for the final exam. The students are expected to present and defend their proposal in class. Grading criteria: Class participation (70%), final paper and presentation (30%).

PATH 525. Protein Misfolding and Human Disease: Molecular Basis and Clinical Implications. 3 Units.
This is a graduate-level seminar course that familiarizes the students with human diseases resulting from aberrations in protein folding, processing, and turnover. Contribution of associated inflammation and heavy metal mis-metabolism will be discussed where appropriate. Specific examples include, but are not limited to, Alzheimer’s Disease, Parkinson’s Disease, Prion disorders multiple sclerosis, amyotrophic lateral sclerosis, Huntington’s Disease, and others based on popular demand. The students will be expected to discuss relevant research publications in an interactive format. Grading will be based on class participation and an R21 grant proposal on the subject of their choice that does not overlap with their current area of research. Recommended Preparation: Concurrent enrollment in PATH 526, on grant-writing skills, is highly recommended but not required. Offered as PATH 525 and CLBY 525.

PATH 526. Introduction to Scientific Grant Writing. 1 Unit.
PATH 526 is a graduate-level course that will familiarize students with grant writing and reviewing skills. The students will be exposed to material pertaining to different grant opportunities, the grant review process, and strategies to maximize your chances of success. Grading will be based on class participation and step-wise preparation of a R21 grant proposal on a topic of your choice that does not overlap with your current area of research. Coreq: PATH 525.

PATH 601. Special Problems. 1 - 18 Units.
Research on the nature and causation of disease and on host factors which tend to protect against disease. Special courses and tutorials in subspecialty areas of general and/or systemic anatomic and/or clinical pathology.

PATH 650. Independent Study. 1 - 9 Units.
Laboratory rotation experience in a selected faculty research laboratory designed to introduce the M.S. student to all aspects of modern laboratory research including the design, execution and analysis of original experimental work.

PATH 651. Thesis M.S.. 1 - 18 Units.
PATH 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Department of Pharmacology
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Phone: 216.368.4617
Krzysztof Palczewski, PhD, Chair
krzysztof.palczewski@case.edu

The Department of Pharmacology offers training leading to MS, PhD or MD/PhD degrees for highly qualified post-undergraduate candidates committed to academic research careers in the biomedical sciences. Adequate preparation in the biological sciences, mathematics, organic chemistry, and physics or physical chemistry is a prerequisite for admission.

Multidisciplinary training, carried out by faculty in pharmacology and other basic science departments, emphasizes molecular, cellular, physiological, and clinical aspects of the pharmacological sciences. Areas of faculty expertise include drug/xenobiotic metabolism; receptor-ligand interactions; and biochemical reaction mechanisms; cell biology of signaling pathways; structure-function of membrane components; endocrine and metabolic regulation; cell surface and nuclear receptors, hormonal regulation of gene expression; cancer biology and therapeutics, bacterial and viral pathogenesis, neuroscience/neuropharmacology, and drug resistance.

Students who desire the combined MD/PhD degrees are admitted to the Medical Scientist Training Program (MSTP; please see separate listing in this publication). These students participate in the two-year integrated preclinical curriculum of the School of Medicine (University Program), which features clinical correlation of basic biologic concepts. Combined degree students who select the PhD in pharmacology undertake a series of advanced courses, research rotations, preliminary examinations and dissertation research in the same manner as that described for the PhD program.

Facilities
The Department of Pharmacology occupies about 25,000 net square feet distributed among several locations, namely the School of Medicine Harland Goff Wood Building and the adjacent Wood Research Tower, as well as facilities in the West Quad Bldg. Facilities include extensive chromatographic and tissue culture facilities, a transgenic mouse laboratory, imaging and confocal microscopy equipment, and ready access to specialized research techniques, including various aspects of recombinant DNA and hybridoma technology, in situ hybridization histochemistry, fluorescence cell sorting, NMR and mass spectroscopy, X-ray crystallography, and cryo electron microscopy.

Masters Degrees
Although training efforts by the Department of Pharmacology are primarily directed toward the award of the PhD degree, training for the MS degree is offered also in a variety of contexts. For example, research assistants in the Department who seek educational advancement may pursue the MS degree via Plan A (thesis) or Plan B (coursework only). Medical students who seek to specialize in Pharmacology during the scholarly research component of their preclinical program may pursue the MS degree. Employees in the Biotechnology Industry may seek advanced training in Pharmacology by pursuing the MS degree at Case. Finally, a PhD candidate who is unable to complete the PhD requirements for extraordinary reasons may petition to have earned credits transferred to fulfill MS degree requirements.

Masters Plan B (Coursework, MS direct admit)
This program is aimed at students who seek a Master’s Degree but do not intend to specialize in research following their Master’s work. To satisfy the requirement for a Comprehensive Exam for the MS Degree, students
register for 1 credit of EXAM 600 during their final semester and sit for a integrative essay question-style examination on the content of the required coursework. A total of 30 credit hours are required (see below).

The advancement of understanding and practice of therapeutics is based on research. Therefore all students in degree programs in Pharmacology are expected to become involved in independent research and scholarship. Registration for PHRM 601 Independent Study and Research requires a pre-arrangement with a faculty mentor who will oversee the combination of study and bench research and proscribe the basis for satisfactory performance, including oral and written reports. With pre-approval of the Departmental Director of Graduate Studies, a student's study plan may substitute additional specific advanced courses to replace PHRM 601 Independent Study and Research credits.

**Sample Plan of Study for Plan B**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>Cell Biology I (CBIO 453)</td>
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<tr>
<td>Molecular Biology I (CBIO 455)</td>
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<tr>
<td>Principles of Pharmacology I: The Molecular Basis of Therapeutics (PHRM 401)</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Pharmacology II: The Physiological Basis of Therapeutics (PHRM 402)</td>
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<tr>
<th>Second Year</th>
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<tr>
<td>Pharmacology Seminar Series (PHRM 511)</td>
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<tr>
<td>PHRM Elective</td>
<td>3</td>
</tr>
<tr>
<td>Independent Study and Research (PHRM 601)</td>
<td>2</td>
</tr>
<tr>
<td>Pharmacology Seminar Series (PHRM 511)</td>
<td>0 - 1</td>
</tr>
<tr>
<td>PHRM Elective</td>
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<td>Independent Study and Research (PHRM 601)</td>
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<td>Master's Comprehensive Exam (EXAM 600)</td>
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| Total Units in Sequence: | 26-28 |

**Masters Plan A (Research, direct admit)**

In addition to the course requirements below, candidates for this degree are required to submit an acceptable written thesis based on their original research, and register for at least 9 credit hours of PHRM 651 Thesis M.S. (master's dissertation research). The acceptability of the thesis will be determined by an oral examination administered by the student's Thesis Advisory Committee. This committee must be chaired by a member of the primary Faculty of Pharmacology, and it should include the research mentor and two other faculty members (total of four faculty members, two from the Department of Pharmacology). As above, a minimum of 27 credit hours are required. For these students, passing the final exams in PHRM 401 Principles of Pharmacology I: The Molecular Basis of Therapeutics and PHRM 402 Principles of Pharmacology II: The Physiological Basis of Therapeutics satisfies the requirement for a Comprehensive Exam for the MS Degree.

**Required courses for Plan A**

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<td>Molecular Biology I (CBIO 455)</td>
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<tr>
<td>Thesis M.S. (PHRM 651)</td>
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<tr>
<td>Principles of Pharmacology I: The Molecular Basis of Therapeutics (PHRM 401)</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Pharmacology II: The Physiological Basis of Therapeutics (PHRM 402)</td>
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| Total Units in Sequence: | 34 |

**MD/MS Biomedical Sciences - Pharmacology**

For Program Admissions information and MD requirements, see MD Dual Degree Programs (p. 724). A sample plan of study for the Pharmacology track is below.

<table>
<thead>
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<th>First Year</th>
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<tr>
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<td>Integrated Biological Sciences II (IBIS 402)</td>
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<table>
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<tr>
<td>Pharmacology Seminar Series (PHRM 511)</td>
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<td>Principles of Pharmacology II: The Physiological Basis of Therapeutics (PHRM 402)</td>
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<tr>
<td>Advanced Elective Course complimentary to research focus</td>
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On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)

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### Third Year

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**Year Total:** 10

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**Year Total:**

### Fifth Year

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**Year Total:**

**Total Units in Sequence:** 37-61

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## PhD in Pharmacology

Students seeking the PhD degree in Pharmacology are admitted into the Department of Pharmacology through the administrative structure of Biomedical Sciences Training Program (http://casemed.case.edu/bstp) which provides an introduction to many related training areas within the biomedical field during the first year. Alternatively, admission may be through the Medical Scientist Training Program (MSTP) (http://mstp.case.edu/default.asp).

The PhD program is divided into three phases. The first phase allows students to follow an integrated first-year sequence of course work that involves a core curriculum in cell and molecular biology. In addition, the first year includes three research rotations that allow the students to sample areas of research and become familiar with faculty members and their laboratories. Selection of a specific training program and thesis advisor is made before the end of the first year. The second phase involves a two part course in intensive Pharmacology study, oral presentations and laboratory experience, which cumulates in a comprehensive written exam designed to challenge students to apply key concepts in new context.

After advancing to PhD candidacy by passing the comprehensive written exam, students select one of four advanced tracks in Pharmacology.

Choice among the tracks is based on the area of research expertise of the thesis advisor and the student’s interest in specific coursework. The four tracks are: Cancer Therapeutics, Membrane Biology and Pharmacology, Molecular Pharmacology and Cell Regulation, and Translational Therapeutics.

The PhD degree is awarded to students who complete a research project leading to two original and meritorious scientific contributions that are submitted for publication to leading journals in the field of study; at least one manuscript must be accepted for publication before scheduling the PhD thesis defense. Completion of the PhD degree will also require 36 hours of coursework (24 hours of which are graded) and 18 hours of PHRM 701 Dissertation Ph.D.

### Core course requirements for the PhD in Pharmacology

The first year consists of the Core curriculum in Cell Biology and Molecular Biology (CBIO 453 Cell Biology I, CBIO 455 Molecular Biology I) and research rotations, as well as a scientific ethics course (15 credit hours). This is included with the additional 15 formal course credit hours which are required in Pharmacology as listed and then described below.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>PHRM 400</td>
<td>Research Experience in Pharmacology</td>
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<tr>
<td>CBIO 453</td>
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<td>CBIO 455</td>
<td>Molecular Biology I</td>
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<tr>
<td>PHRM 401</td>
<td>Principles of Pharmacology I: The Molecular Basis of Therapeutics</td>
<td>3</td>
</tr>
<tr>
<td>PHRM 402</td>
<td>Principles of Pharmacology II: The Physiological Basis of Therapeutics</td>
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</tr>
<tr>
<td>PHRM 511</td>
<td>Pharmacology Seminar Series</td>
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</tr>
<tr>
<td>PHRM 525</td>
<td>Topics in Cell and Molecular Pharmacology</td>
<td>0 - 18</td>
</tr>
</tbody>
</table>

**Total Units:** 18-38

### Plan of Study

**§ Please also see Graduate Studies Academic Requirements for Doctoral Degrees**

<table>
<thead>
<tr>
<th>Year</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
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<tr>
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<td>Molecular Biology I (CBIO 455)</td>
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<tr>
<td>Independent Study and Research (PHRM 601)</td>
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<td>1-9</td>
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<tr>
<td>Selection of Thesis Advisor</td>
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<tr>
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<tr>
<td>Independent Study and Research (PHRM 601)</td>
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</table>
Pharmacology Seminar Series (PHRM 511) 0 - 1

On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500) 1

Year Total: 7-15 7-16 1

Second Year

<table>
<thead>
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<th>Course</th>
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<td>Independent Study and Research (PHRM 601)</td>
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<tr>
<td>Pharmacology Seminar Series (PHRM 511)</td>
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<td>Prelim I (During January, Year 2) Admission to candidacy</td>
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<tr>
<td>Pharmacology Seminar Series (PHRM 511)</td>
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<td>Advanced Track Elective 2</td>
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<td>Topics in Cell and Molecular Pharmacology (PHRM 525)</td>
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Total Units in Sequence: 26-80

* Rotation 1 takes place during Summer prior to First Year Fall Semester.

Courses

**PHRM 301. Undergraduate Research. 1 - 18 Units.**

**PHRM 309. Principles of Pharmacology. 3 Units.**
Principles of Pharmacology introduces the basic principles that underlie all of Pharmacology. The first half of the course introduces, both conceptually and quantitatively, drug absorption, distribution, elimination and metabolism (pharmacokinetics) and general drug receptor theory and mechanism of action (pharmacodynamics). Genetic variation in response to drugs (pharmacogenetics) is integrated into these basic principles. The second half of the course covers selected drug classes chosen to illustrate these principles. Small group/recitation sessions use case histories to reinforce presentation of principles and to discuss public perceptions of therapeutic drug use. Graduate students will be expected to critically evaluate articles from the literature and participate in a separate weekly discussion session. Recommended preparation for PHRM 409: Undergraduate degree in science or permission of instructor. Offered as PHRM 309 and PHRM 409. (CHEM 223 and CHEM 224), or (CHEM 323 and CHEM 324), or (EBME 201 and EBME 202), or (BIOL 116 and BIOL 117).

**PHRM 315. Nuclear Receptors in Health and Disease. 3 Units.**
This course focuses on hormone-gene interactions mediated by the ligand-inducible transcription factors termed nuclear hormone receptors. The class will address the mechanisms of action, regulatory features, and biological activities of several nuclear receptors. The usage of nuclear receptors as therapeutic targets in disease states such as cancer, inflammation, and diabetes will also be discussed. The course aims to teach students to critically evaluate primary literature relevant to nuclear hormone receptors biology, and to reinforce presentation/discussion skills. Grades for undergraduates will be based on midterm, final exam; grades for graduates will be based on midterm, final exam, and presentation of a recently published research article related to the role of nuclear receptors in health and disease. Offered as PHRM 315, BIOC 315, PHRM 415 and BIOC 415.

**PHRM 340. Science and Society Through Literature. 3 Units.**
This course will examine the interaction of scientific investigation and discovery with the society it occurred in. What is the effect of science on society and, as importantly, what is the effect of society on science? An introduction will consider the heliocentric controversy with focus on Galileo. Two broad areas, tuberculosis and the Frankenstein myth, will then be discussed covering the period 1800-present. With tuberculosis, fiction, art and music will be examined to understand the changing views of society towards the disease, how society’s perception of tuberculosis victims changed, and how this influenced their treatments and research. With Frankenstein, the original novel in its historical context will be examined. Using fiction and film, the transformation of the original story into myth with different connotations and implications will be discussed. Most classes will be extensive discussions coupled with student presentations of assigned materials. Offered as PHRM 340, BETH 440, PHRM 440, and HSTY 440.

**PHRM 400. Research Experience in Pharmacology. 0 - 1 Units.**
Research rotation in pharmacology.

**PHRM 401. Principles of Pharmacology I: The Molecular Basis of Therapeutics. 3 Units.**
This core course focuses on the chemical and biochemical properties of therapeutic agents and molecular mechanisms of therapeutic action, including kinetic and thermodynamic principles of enzyme catalysis and drug-receptor interactions. Moreover, emphasis is placed on fundamental principles of pharmacokinetics, including the absorption, distribution, metabolism, and excretion of drugs. Mathematical concepts needed to understand appropriate administration of drugs and maintaining therapeutic concentrations of drugs in the body are discussed. A second broad area of emphasis is on fundamental principles of pharmacodynamics, including drug-receptor theory, log dose-response relationships, therapeutic index, receptor turnover, and signal transduction mechanisms. The primary learning objective is to develop a self-directed, critical approach to the evaluation and design of experimental research in the broad context of receptor interactions with endogenous ligands and therapeutic agents in the context of disease models. This is a team-coordinated course involving session organized by faculty to facilitate student-directed learning experiences including discussion of study questions, problem solving applications, and primary literature presentations. A two-part laboratory exercise introduces experimental methodologies widely applied during the study of molecular interactions between therapeutic agents and receptor targets to reinforce fundamental principles of drug action. This 3-credit hour course meets 3 hr per week during the spring semester of year 1.
PHRM 402. Principles of Pharmacology II: The Physiological Basis of Therapeutics. 3 Units.
This course focuses on human physiology of organ systems including the central nervous system, cardiovascular system, and those systems (gastrointestinal, hepatic, and renal) that are involved in determining the pharmacokinetics or time course of drug action in vivo. A second major emphasis is placed on disease-based sessions where normal physiology, pathophysiology, and key drug classes to treat pathophysiologies are discussed. The students learn key concepts in endocrine pathologies, inflammatory disorders, pulmonary diseases, infectious diseases, and cancer. The main learning objectives are for the student to gain an understanding of basic principles of modern pharmacology and physiology and to build self-directed learning skills. This is a highly interactive course in which faculty lectures are minimized. A heavy emphasis is placed on student-directed learning experiences including presentation and discussion of primary literature, problem solving applications, small group discussion and team-based learning. This 3-credit hour course meets 3 hr per week during the fall semester of year 2.

PHRM 403. Public and Professional Views of Modern Therapeutics. 3 Units.
This course will present the students with headline news stories from the popular press along with pertinent published articles from the scientific literature. The object is to engage the students in critical evaluation of the scientific literature and news reports to discern the scientific basis for decisions such as removal of drugs from the market. The course will focus on topics such as Cox-2 Inhibitors and Heart Disease, Antidepressant Use for Adolescents, and Parkinson’s Disease and Stem Cell Therapy, among others. Evaluation will be based on participation in student-led discussion sessions, weekly topical quizzes, and on written critiques of the primary literature.

PHRM 406. Basic Cancer Biology and the Interface with Clinical Oncology. 3 Units.
This is a graduate-level introductory course in cancer biology taught through the Departments of Pharmacology and Pathology. This course will give students a broad overview of current basic cancer biology, highlight recent advances in cancer therapeutics, and provide a clinical perspective of the pathogenesis and treatment of common cancers. Classes will be of lecture and discussion format, and will also include student discussion of journal research articles to develop critical thinking in cancer research and experimental design as well as presentation/communication skills. About 1 to 3 students per class will be scheduled to lead the presentation and discussion of the selected journal articles. However, all students will be required to read the material in advance and be ready for discussion. Topics will cover growth factor action and signal transduction, oncogenes, tumor suppressor genes, DNA damage, apoptosis, cancer immunology, cancer stem cells, metastasis, angiogenesis, chemotherapy, radiation therapy, targeted therapeutics, photodynamic therapy, targeting cancer stem cells, chemoprevention, and clinical aspects of cancers of the breast, prostate, lymphatic tissue, and colon. Course grades for PHRM/PATH 520 (Ph.D. track): will be determined by class participation/presentation (40%), an original research grant proposal (35%) and written and oral critiques of two research proposals (25%). Course grades for PHRM/PATH 406 (M.S. and non-degree track): will be determined by class participation/presentation (40%), a literature review term paper (35%) and oral defense of term paper with course directors (25%). Presentations/Participation: Instructors will complete a standardized evaluation form to provide you uniform feedback in a timely manner. Required Reading: Assigned reviews, original articles (in blackboard) Recommended Reading: The Biology of Cancer (2nd Edition), by Robert A. Weinberg Garland Science, copyright 2014 Recommended Preparation: A course in Cell Biology. A course in Molecular Biology. Offered as PATH 406, PATH 520, PHRM 406 and PHRM 520.

PHRM 409. Principles of Pharmacology. 3 Units.
Principles of Pharmacology introduces the basic principles that underlie all of Pharmacology. The first half of the course introduces, both conceptually and quantitatively, drug absorption, distribution, elimination and metabolism (pharmacokinetics) and general drug receptor theory and mechanism of action (pharmacodynamics). Genetic variation in response to drugs (pharmacogenetics) is integrated into these basic principles. The second half of the course covers selected drug classes chosen to illustrate these principles. Small group/recitation sessions use case histories to reinforce presentation of principles and to discuss public perceptions of therapeutic drug use. Graduate students will be expected to critically evaluate articles from the literature and participate in a separate weekly discussion session. Recommended preparation for PHRM 409: Undergraduate degree in science or permission of instructor. Offered as PHRM 309 and PHRM 409.

PHRM 412. Membrane Transport Processes. 3 Units.
Membranes and membrane transporters are absolutely required for all cells to take up nutrient, maintain membrane potential and efflux toxins. This course will consider the classification and structure of membrane transport proteins and channels, examine the common mechanistic features of all systems and the specific features of different classes of transporter. Understanding the physiological integration of transport processes into cell homeostasis and consideration of transporters and channels as drug targets will be a goal. Course format is minimal lecture, primarily student presentations of primary literature papers. Offered as PHOL 412 and PHRM 412. Prereq: CBIO 453 and CBIO 455.
PHRM 415. Nuclear Receptors in Health and Disease. 3 Units.
This course focuses on hormone-gene interactions mediated by the ligand-inducible transcription factors termed nuclear hormone receptors. The class will address the mechanisms of action, regulatory features, and biological activities of several nuclear receptors. The usage of nuclear receptors as therapeutic targets in disease states such as cancer, inflammation, and diabetes will also be discussed. The course aims to teach students to critically evaluate primary literature relevant to nuclear hormone receptors biology, and to reinforce presentation/discussion skills. Grades for undergraduates will be based on midterm, final exam; grades for graduates will be based on midterm, final exam, and presentation of a recently published research article related to the role of nuclear receptors in health and disease. Offered as PHRM 315, BIOC 315, PHRM 415 and BIOC 415.

PHRM 420. Current Topics in Cancer. 3 Units.
The concept of cancer hallmarks has provided a useful guiding principle in our understanding of the complexity of cancer. The hallmarks include sustaining proliferative signaling, evading growth suppressors, enabling replicative immortality, activating invasion and metastasis, inducing angiogenesis, resisting cell death, deregulating cellular energetics, avoiding immune destruction, tumor-promoting inflammation, and genome instability and mutation. The objectives of this course are to (1) examine the principles of some of these hallmarks, and (2) explore potential therapies developed based on these hallmarks of cancer. This is a student-driven and discussion-based graduate course. Students should have had some background on the related subjects and have read scientific papers in their prior coursework. Students will be called on to present and discuss experimental design, data and conclusions from assigned publications. There will be no exams or comprehensive papers but students will submit a one-page critique (strengths and weaknesses) of one of the assigned papers prior to each class meeting. The course will end with a full-day student-run symposium on topics to be decided jointly by students and the course director. Grades will be based on class participation, written critiques, and symposium presentations. Offered as BIOC 420, MBI0 420, PATH 422, and PHRM 420. Prereq: CBIO 453 and CBIO 455.

PHRM 430. Advanced Methods in Structural Biology. 1 - 6 Units.
The course is designed for graduate students who will be focusing on one or more methods of structural biology in their thesis project. This course is divided into 3-6 sections (depending on demand). The topics offered will include X-ray crystallography, nuclear magnetic resonance spectroscopy, optical spectroscopy, mass spectrometry, cryo-electron microscopy, and computational and design methods. Students can select one or more modules. Modules will be scheduled so that students can take all the offered modules in one semester. Each section is given in 5 weeks and is worth 1 credit. Each section covers one area of structural biology at an advanced level such that the student is prepared for graduate level research in that topic. Offered as BIOC 430, CHEM 430, PHOL 430, and PHRM 430.

PHRM 432. Current Topics in Vision Research. 3 Units.
Vision research is an exciting and multidisciplinary area that draws on the disciplines of biochemistry, genetics, molecular biology, structural biology, neuroscience, and pathology. This graduate level course will provide the student with broad exposure to the most recent and relevant research currently being conducted in the field. Topics will cover a variety of diseases and fundamental biological processes occurring in the eye. Regions of the eye that will be discussed include the cornea, lens, and retina. Vision disorders discussed include age-related macular degeneration, retinal ciliopathies, and diabetic retinopathy. Instructors in the course are experts in their field and are members of the multidisciplinary visual sciences research community here at Case Western Reserve University. Students will be exposed to the experimental approaches and instrumentation currently being used in the laboratory and in clinical settings. Topics will be covered by traditional lectures, demonstrations in the laboratory and the clinic, and journal club presentations. Students will be graded on their performance in journal club presentations (40%), research proposal (40%), and class participation (20%). Offered as NEUR 432, PATH 432, PHRM 432 and BIOC 432.

PHRM 440. Science and Society Through Literature. 3 Units.
This course will examine the interaction of scientific investigation and discovery with the society it occurred in. What is the effect of science on society and, as importantly, what is the effect of society on science? An introduction will consider the heliocentric controversy with focus on Galileo. Two broad areas, tuberculosis and the Frankenstein myth, will then be discussed covering the period 1800-present. With tuberculosis, fiction, art and music will be examined to understand the changing views of society towards the disease, how society’s perception of tuberculosis victims changed, and how this influenced their treatments and research. With Frankenstein, the original novel in its historical context will be examined. Using fiction and film, the transformation of the original story into myth with different connotations and implications will be discussed. Most classes will be extensive discussions coupled with student presentations of assigned materials. Offered as PHRM 340, BETH 440, PHRM 440, and HSTY 440.

PHRM 466. Cell Signaling. 3 Units.
This is an advanced lecture/journal/discussion format course that covers cell signaling mechanisms. Included are discussions of neurotransmitter-gated ion channels, growth factor receptor kinases, cytokine receptors, G protein-coupled receptors, steroid receptors, heterotrimeric G proteins, ras family GTPases, second messenger cascades, protein kinase cascades, second messenger regulation of transcription factors, microtubule-based motility, actin/myosin-based motility, signals for regulation of cell cycle, signals for regulation of apoptosis. Offered as CLBY 466, PHOL 466 and PHRM 466.

PHRM 475. Protein Biophysics. 3 Units.
This course focuses on in-depth understanding of the molecular biophysics of proteins. Structural, thermodynamic and kinetic aspects of protein function and structure-function relationships will be considered at the advanced conceptual level. The application of these theoretical frameworks will be illustrated with examples from the literature and integration of biophysical knowledge with description at the cellular and systems level. The format consists of lectures, problem sets, and student presentations. A special emphasis will be placed on discussion of original publications. Offered as BIOC 475, CHEM 475, PHOL 475, PHRM 475, and NEUR 475.

PHRM 511. Pharmacology Seminar Series. 0 - 1 Units.
Current topics of interest in the pharmacologist sciences.
PHRM 513. Structural Journal Club. 1 Unit.
Current topics of interest in structural biology, and protein biophysics. Offered as PHOL 513 and PHRM 513.

PHRM 520. Basic Cancer Biology and the Interface with Clinical Oncology. 3 Units.
This is a graduate-level introductory course in cancer biology taught through the Departments of Pharmacology and Pathology. This course will give students a broad overview of current basic cancer biology, highlight recent advances in cancer therapeutics, and provide a clinical perspective of the pathogenesis and treatment of common cancers. Classes will be of lecture and discussion format, and will also include student discussion of journal research articles to develop critical thinking in cancer research and experimental design as well as presentation/communication skills. About 1 to 3 students per class will be scheduled to lead the presentation and discussion of the selected journal articles. However, all students will be required to read the material in advance and be ready for discussion. Topics will cover growth factor action and signal transduction, oncogenes, tumor suppressor genes, DNA damage, apoptosis, cancer immunology, cancer stem cells, metastasis, angiogenesis, chemotherapy, radiation therapy, targeted therapeutics, photodynamic therapy, targeting cancer stem cells, chemoprevention, and clinical aspects of cancers of the breast, prostate, lymphatic tissue, and colon. Course grades for PHRM/PATH 520 (Ph.D. track): will be determined by class participation/presentation (40%), an original research grant proposal (35%) and written and oral critiques of two research proposals (25%). Course grades for PHRM/PATH 406 (M.S. and non-degree track): will be determined by class participation/presentation (40%), a literature review term paper (35%) and oral defense of term paper with course directors (25%). Presentations/Participation: Instructors will complete a standardized evaluation form to provide you uniform feedback in a timely manner. Required Reading: Assigned reviews, original articles (in blackboard) Recommended Reading: The Biology of Cancer (2nd Edition), by Robert A. Weinberg Garland Science, copyright 2014 Recommended Preparation: A course in Cell Biology. A course in Molecular Biology. Offered as PATH 406, PATH 520, PHRM 406 and PHRM 520.

PHRM 521. Special Topics in Cancer Biology and Clinical Oncology. 1 Unit.
This one credit hour course in Cancer Biology is intended to give students an opportunity to do independent literature research while enrolled in PHRM 520/PATH 520. Students must attend weekly Hematology/Oncology seminar series and write a brief summary of each of the lectures attended. In addition, students must select one of the seminar topics to write a term paper which fully reviews the background related to the topic and scientific and clinical advances in that field. This term paper must also focus of Clinical Oncology, have a translational research component, and integrate with concepts learned in PHRM 520/PATH 520. Pharmacology students must provide a strong discussion on Therapeutics, while Pathology students must provide a strong component on Pathophysiology of the disease. Recommended preparation: CBIO 453 and CBIO 455, or concurrent enrollment in PHRM 520 or PATH 520. Offered as PATH 521 and PHRM 521.

PHRM 525. Topics in Cell and Molecular Pharmacology. 0 - 18 Units.
Individual library research project under the guidance of a pharmacology sponsor. Projects will reflect the research interest of the faculty sponsor, including molecular endocrinology, neuropharmacology, receptor activation and signal transduction, molecular mechanisms of enzyme action and metabolic regulation.

PHRM 526. Grant Writing Tutorial. 1 - 3 Units.
Students will be expected to provide critiques of a grant proposal to bring to a workshop. At the workshop, a faculty review panel will discuss the grant proposal and provide critiques to illustrate the key components that are necessary for any grant proposal, and the specific items that enhance the quality of the proposal or detract from it. The students will be able to compare what they emphasized in their critiques to what the expert panel focused on. After completing the workshop, each student will prepare a proposal based on their thesis topic; this document will be scored, and the student will also be evaluated for an oral defense of the proposal.

PHRM 527. Pathways to Personalized Medicine. 3 Units.
This is a course of independent study designed to take the student from the bedside to the bench and back again. Students will select a problem from a list of important therapeutic issues related to variability in drug responsiveness and design a research program to elucidate its molecular, biochemical, genetic and pathophysiological basis. The resulting research proposal is expected to be multidimensional and include molecular, cellular, whole animal and clinical investigations. To guide the process students will assemble a mentoring group including at least one member of the Translational Therapeutics Track Faculty, a clinician working in the clinical realm in which the problem originates and a basic scientist with relevant experience. The written proposal will be defended orally. Recommended preparation: 1st year Pharm Graduate required courses.

PHRM 528. Contemporary Approaches to Drug Discovery. 3 Units.
This course is designed to teach the students how lead compounds are discovered, optimized, and processed through clinical trials for FDA approval. Topics will include: medicinal chemistry, parallel synthesis, drug delivery and devices, drug administration and pharmacokinetics, and clinical trials. A special emphasis will be placed on describing how structural biology is used for in silico screening and lead optimization. This component will include hands-on experience in using sophisticated drug discovery software to conduct in silico screening and the development of drug libraries. Each student will conduct a course project involving in silico screening and lead optimization against known drug targets, followed by the drafting of an inventory disclosure. Another important aspect of this course will be inclusion of guest lectures by industrial leaders who describe examples of success stories of drug development. Offered as BIOC 528, PHOL 528, PHRM 528, and SYBB 528.

PHRM 555. Current Proteomics. 3 Units.
This course is designed for graduate students across the university who wish to acquire a better understanding of fundamental concepts of proteomics and hands-on experience with techniques used in current proteomics. Lectures will cover protein/peptide separation techniques, protein mass spectrometry, bioinformatics tools, and biological applications which include quantitative proteomics, protein modification proteomics, interaction proteomics, structural genomics and structural proteomics. Laboratory portion will involve practice on the separation of proteins by two-dimensional gel electrophoresis, molecular weight measurement of proteins by mass spectrometry, peptide structural characterization by tandem mass spectrometry and protein identification using computational tools. The instructors' research topics will also be discussed. Recommended preparation: CBIO 453 and CBIO 455. Offered as PHRM 555 and SYBB 555.
PHRM 600. Preparation for Qualifying Exam. 1 Unit.
Students pursuing the M.S. or Ph.D. degrees in Pharmacology are required to prepare systematically for the comprehensive qualifying exam by reviewing the concepts of cellular and molecular biology and pharmacology. The qualifier is comprised of a two-part written exam administered simultaneously to all eligible students. It is designed to evaluate their understanding of concepts presented in the various core courses. It also assesses their skills in critical reading of research articles and design of experiments. The division into two parts allows each student to receive feedback on deficient areas and work toward improvement on the second segment. Eligibility: Students may register for the exam when they have fulfilled two criteria: (a) Successful completion (grade B or better) in all of the Core Courses, and an overall GPA of 3.0 or better. (b) Satisfactory performance in all research rotations and consistent research effort in the thesis laboratory as documented formally by the Ph.D. mentor. No student on probation may sit for the Qualifying Exam (Prelim I). Prereq: CBIO 453, CBIO 455, PHRM 401 and PHRM 402.

PHRM 601. Independent Study and Research. 1 - 18 Units.

PHRM 651. Thesis M.S.. 1 - 18 Units.

PHRM 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

Physician Assistant Program

Master of Science in Physician Assistant Studies

Cynthia Booth Lord, MHS, PA-C
PA Program Director
David Shafran, MD, MA
Director of Admissions
PAProgram@case.edu or 216.368.0575
https://case.edu/medicine/physician-assistant/

CWRU PA Program Curriculum Overview

The Case Western Reserve University PA program is a 102 credit-hour professional degree program that spans the course of 27 months. The program is a generalist program preparing learners to be leaders in PA practice in a variety of clinical settings. This intensive full-time graduate curriculum awards a Master of Science in Physician Assistant Studies (MSc in Physician Assistant Studies) from the School of Medicine upon completion. The curriculum, which must be successfully completed in order to meet program requirements for graduation, enables graduates to sit for the PA National Certifying Examination (administered by the National Commission on Certification of Physician Assistants) and obtain a state license.

The educational philosophy of the PA program emphasizes the practice of evidence-based, patient-centered medical care as well as accountability to patients, society and the profession through experiential learning and active community involvement. The first 15 months of the program are didactic in nature, divided into four semesters. This is followed by 12 months of clinical instruction comprised of twelve, four-week clinical rotations. Early clinical exposure is accomplished through pre-clinical clerkships in the first year. The PA program begins each year in May and ends in August. Students are recruited from the CASPA system.

The program design utilizes a hybrid blend of learning methodologies and styles including:

- Asynchronous learning
- Clinical simulations
- Case-based learning and clinical correlations
- Experiential learning in the community-the community is the "learning lab" of the PA program. Wellness, prevention, professionalism, communication skills and philanthropy are best taught directly in the community with patients in their own environment.
- Early clinical exposure/Pre-clinical clerkships-by the beginning of November of their first year, PA students are placed in clinical sites in the community for one half day a week to practice their clinical skills and begin to acculturate to the clinical environment and learn how to function on a team. The focus of this experience is to hone the students' clinical skills in history, physical exam, oral presentation, medical documentation, communication skills and professionalism. It also serves as an early critical-thinking activity.
- Medical writing across the curriculum (MWAC) is introduced in the didactic phase through student reflections and progress in the clinical phase to scientific poster, hot topic and oral case presentations.

Organization and sequencing of coursework is both horizontally and vertically integrated facilitating a connected flow of systems and conditions, creating a curricular thread intended to enhance the development of critical thinking and problem solving. Planned redundancies help build a strong pre-clinical knowledge base. Through demonstrations, case discussions and simulation activities, students learn critical thinking and how to synthesize information to formulate and implement a patient management plan. Simulation activities allow the students to participate in scenarios that closely approximate real life patient encounters and, through a team based approach (small group), create their care plans. Hands on activities enhance the student’s ability to develop their critical thinking and technical skills. Experiential learning through community engagement introduces students to some of the concepts of team-based care and population health.

Physician Assistant Program Plan of Study-27 Months

Didactic Curriculum Summer Semester I, Fall Semester I, and Spring Semester I

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<td>Professional Issues for PA’s-History &amp; Roles of the PA I (PAST 411)</td>
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<tr>
<td>Cadaver dissection-based human anatomy with histology and physiologic correlations (PAST 410)</td>
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<tr>
<td>Physical Diagnosis (PAST 402)</td>
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<tr>
<td>Medical Microbiology &amp; Infectious Disease (PAST 405)</td>
<td>2</td>
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</table>
### Physician Assistant Program

#### Pharmacology I (PAST 420) 2
Principles of Internal Medicine (PAST 430) 7
Pre-Clinical Clerkships I (PAST 440) 1
Human Physiology (PAST 477) 4
Ethics in Healthcare Delivery (PAST 406) 1
Professional Issues for Physician Assistants II (PAST 412) 2
Pharmacology II (PAST 421) 3
Principles of Clinical Medicine-Surgery & Emergency Medicine (PAST 431) 4
Principles of Clinical Medicine-OB/GYN (PAST 432) 3
Principles of Clinical Medicine-Pediatrics (PAST 433) 3
Principles of Clinical Medicine-Behavioral Medicine (PAST 434) 2
Pre-Clinical Clerkships II (PAST 441) 1
Year Total: 12 20 19

Total Units in Sequence: 51

#### Didactic Curriculum Summer Semester II

<table>
<thead>
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<tr>
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<td>Culture and Health (PAST 450)</td>
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<td>Introduction to Public Health (PAST 451)</td>
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<td></td>
<td>Introduction to Evidence Based Medicine (PAST 452)</td>
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<td></td>
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Total Units in Sequence: 12

#### Clinical Curriculum Year

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<thead>
<tr>
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<td>PAST 500</td>
<td>Clinical Residency: Emergency Medicine Rotation</td>
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<td>PAST 501</td>
<td>Clinical Residency: Family Medicine</td>
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<td>PAST 502</td>
<td>Clinical Residency: Geriatrics</td>
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<td>PAST 503</td>
<td>Clinical Residency: Internal Medicine Rotation</td>
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<td>PAST 504</td>
<td>Clinical Residency: Obstetrics &amp; Gynecology</td>
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<td>PAST 505</td>
<td>Clinical Residency: Pediatrics</td>
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<td>PAST 506</td>
<td>Clinical Residency: Behavioral and Mental Health</td>
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<td>PAST 507</td>
<td>Clinical Residency: Surgery</td>
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<td>Clinical Residency: Primary Care Elective</td>
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<td>Clinical Residency: Inpatient Medicine Elective</td>
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<td>PAST 510</td>
<td>Clinical Residency: Elective</td>
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<td>PAST 511</td>
<td>Clinical Residency: Elective</td>
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<tr>
<td>PAST 600</td>
<td>Capstone Quality Improvement Project &amp; Comprehensive Examination</td>
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Required Clinical Experience Credit hours = 39 hours
Total Credit Hours to Complete Program: 102

#### Courses

**PAST 401. Foundations of Clinical Medicine-Principles of Interviewing. 3 Units.**
The general purpose of this course is to teach the physician assistant student the skills necessary to conduct a clinical/medical interview with a patient and to be able to present the information to other health care professionals in both an oral and written form. This course, which is designed as small, group seminars, will focus on the skills necessary to question patients in a directed fashion and to listen to the patient with concern and empathy. Instruction will emphasize what data is needed in a complete medical history as well as the focused interview, the proper technique for gathering information, and the format for presentation of the data. Instructional techniques will include role-playing, small group discussion, and observation and critique by instructors, other students and simulated patient models. Prereq: Students must be in Physician Assistant Program.

**PAST 402. Physical Diagnosis. 4 Units.**
This lecture/discussion/laboratory course presents and explores the techniques for performing a complete and competent physical examination, understanding the pathophysiology presented by the patient, and organizing and reporting the findings in both written and oral format. Synthesis of historical and physical presentations for an accurate evaluation of the patient will be emphasized. The problem-oriented physical examination and special examination tools and techniques will be presented. Instructional techniques will include small group discussion, practical experience with other students and faculty, and the observation and critique of physical examination skills by faculty. Prereq: Students must be in Physician Assistant Program.

**PAST 403. Diagnostic Methods-Clinical Lab. 1 Unit.**
This course is designed to introduce the student to clinical laboratory medicine. Lectures are designed to review the various types of laboratory tests, acquisition and handling of specimens, normal values as well as interpretation of results and correlation with clinical conditions. Prereq: Students must be in Physician Assistant Program.

**PAST 404. Clinical Correlations. 1 Unit.**
This seminar course places emphasis on internal organs with clinical correlation to anatomic conditions. Content will include basis concepts of genetics, embryology, the comparison of normal and abnormal structural relationships and the demonstration of how these things relate to health and disease. Students will review on-line genetics learning modules and meet in small seminar groups to review anatomical clinical correlates. Prereq: Students must be in Physician Assistant Program.
PAST 405. Medical Microbiology & Infectious Disease. 2 Units.
This course is the study of microorganisms and the diseases they cause in man. It includes consideration of infectious disease microorganisms including their biochemical, serological and virulence characteristics, and clinical manifestations. An organ system approach is used to examine the fundamentals of pathogenicity, host response, epidemiological aspects of infectious disease, as well as clinical manifestations, diagnosis and treatment of infections with clinical correlations. Prereq: Students must be in Physician Assistant Program.

PAST 406. Ethics in Healthcare Delivery. 1 Unit.
This course is an overview of the discipline of medical ethics presenting the study and application of relevant principles, insights, and understandings of modern medical practice. The course includes a brief overview of ethical theories which lay the foundation for subsequent investigation into specific ethical problems found in medical science and technology. The purpose of the course is to provide a framework which enables the student to reason clearly and effectively about the ethics involved in medical science and technology. The course assumes no prior knowledge of philosophical ethics or medical science. A framework of ethical decision making is introduced and practiced using realistic medical cases via a Medical Ethics Committee. Prereq: Students must be in Physician Assistant Program.

PAST 407. Clinical Procedures. 4 Units.
The purpose is to prepare these future clinicians for clinical management of health and disease by preparing them for common clinical procedures. These will include basic and advanced surgical skills, basic laboratory skills, common out-patient procedures, common emergency procedures, and interpretation of electrocardiographs and common radiologic tests. Prereq: Students must be in Physician Assistant Program.

PAST 410. Cadaver dissection-based human anatomy with histology and physiologic correlations. 6 Units.
This course will provide students with a sound understanding of the normal human body as a foundation for subsequent pursuing biomedical careers. A combination of daily lectures and laboratories integrates cadaver dissection-based gross anatomy with the associated histology, embryology, neuroanatomy and basic physiology. This course is well-suited to all biomedical careers, including pre-clinical and biomedical undergraduates, post-baccalaureate, pre-clinical master of science graduate programs, plus medical and dental students seeking additional training in the anatomical sciences. It will meet any of the anatomy-oriented prerequisites being implemented for medical and dental school applications, including those preferring or requiring a cadaver-based experience. The assessments will include a combination of written and cadaver-based practical questions. Offered as ANAT 410 and PAST 410. Prereq: Students must be in Physician Assistant Program.

PAST 411. Professional Issues for PA's-History & Roles of the PA I. 1 Unit.
This one semester course explores through lecture and discussion the factors affecting the development of the profession and role socialization with emphasis on history, regulations and organizations governing PA practice. An overview of clinical responsibilities, team based practice, population health and the PAs role, licensing and credentialing practices will be presented and discussed. Prereq: Students must be in Physician Assistant Program.

PAST 412. Professional Issues for Physician Assistants II. 2 Units.
In this three course series students will explore factors affecting the development of the profession, the status of the PA in the U.S. healthcare system and current issues in clinical practice including practice-based improvement and systems-based practice. Through lecture and discussion, this series prepares the student for the transition from classroom to clinical training and clinical practice. Emphasis is given to the responsibilities that come with being a professional, professionalism and practicing quality improvement. Prereq: Students must be in Physician Assistant Program.

PAST 413. Professional Issues for Physician Assistants III. 2 Units.
In this three course series students will explore factors affecting the development of the profession, the status of the PA in the U.S. healthcare system and current issues in clinical practice including practice-based improvement and systems-based practice. Through lecture and discussion, this series prepares the student for the transition from classroom to clinical training and clinical practice. Emphasis is given to the responsibilities that come with being a professional, professionalism and practicing quality improvement. Prereq: Students must be in Physician Assistant Program.

PAST 420. Pharmacology I. 2 Units.
In this two course series, (PAST 421 Pharmacology II) students will be provided with a basic introduction to the principles of pharmacology and to drug classes of particular relevance to the physician assistant. Information concerning drug doses and calculations used in determining doses will be included in this course and PAST 421 Pharmacology. Prereq: Students must be in Physician Assistant Program.

PAST 421. Pharmacology II. 3 Units.
In this two course series (PAST 420 Pharmacology), physician assistant students will be provided with foundational knowledge of the therapeutic uses and effects of drugs. The indications, contraindications and adverse effects of prototypical drugs are covered. Drug dependence and addiction are also discussed. This course also includes a problem-based learning component which will enhance students’ teamwork and clinical reasoning skills by examining and analyzing case scenarios in small groups. Prereq: Students must be in Physician Assistant Program.

PAST 430. Principles of Internal Medicine. 7 Units.
This one semester lecture/discussion course provides students with a detailed study of the etiology, pathophysiology, signs, symptoms, diagnosis and treatment of various disorders encountered in internal medicine. A broad array of diseases in cardiology, dermatology, endocrinology, gastroenterology, gerontology, hepatology, hematology, oncology, urology, nephrology, neurology, pulmonary and rheumatology are explored. Prereq: Students must be in Physician Assistant Program.

PAST 431. Principles of Clinical Medicine-Surgery & Emergency Medicine. 4 Units.
This one semester lecture course presents the fundamentals of surgical disease and care of the acutely injured and ill patients. The purpose is to familiarize the student with the etiology, anatomy, pathophysiology, clinical manifestations and appropriate diagnosis and treatment of selected surgical conditions and conditions encountered in the surgical subspecialty and emergency medical settings. Prereq: Students must be in Physician Assistant Program.
PAST 432. Principles of Clinical Medicine-OB/GYN. 3 Units.
This lecture/case presentation course gives the student an overview of commonly encountered obstetric and gynecologic disorders. Anatomy and physiology of the human reproduction system are examined, including the changes in pregnancy, prenatal care, medical and surgical complications of pregnancy, pre- and postpartum care. Common gynecologic conditions, methods and effectiveness of contraception, cancer detection methods and the diagnosis and treatment of sexually transmitted infections in the female are explored. Prereq: Students must be in Physician Assistant Program.

PAST 433. Principles of Clinical Medicine-Pediatrics. 3 Units.
This course introduces the student to a unique, complex and challenging field of pediatrics. It emphasizes aspects of general pediatrics and provides a foundation for those students who elect to further study the health care of infants, children and adolescents. This course addresses issues unique to childhood and adolescence by focusing on human developmental biology, and by emphasizing the impact of family, community, and society on child health and well-being. Additionally, it focuses on the impact of disease and its treatment on the developing human, and emphasizes growth and development, principles of health supervision, and recognition of common health problems. Prereq: Students must be in Physician Assistant Program.

PAST 434. Principles of Clinical Medicine-Behavioral Medicine. 2 Units.
This one semester course gives students an overview of some of the most important areas in behavioral psychiatry. This course is an overview of basic psychiatric concepts and focuses on assessing patients who manifest psychological symptoms. Topics include diagnosis and treatment of anxiety disorders, mood disorders, common child and adolescent disorders, somatoform and factitious disorders, psychotic disorders, sleep disorders, adjustment and personality disorders, and drug and alcohol abuse and addresses forensic issues in behavioral health. Prereq: Students must be in Physician Assistant Program.

PAST 440. Pre-Clinical Clerkships I. 1 Unit.
This course/clerkship provides the student with clinical experience at clinical sites in the didactic year utilizing what was learned in Foundations of Clinical Medicine (Interviewing and Physical Diagnosis class/lab). During the pre-clinical time at program designated sites, students will continue to develop and apply their history and physical exam skills, interpersonal skills, oral presentation and medical documentation skills. For expanding skills and creating relationships within the community, this course also encompasses community service, experiential learning and interprofessional education activities. This course/clerkship will help to better prepare students to gain experience and develop confidence in approaching patients prior to entering the clinical year. Prereq: Students must be in Physician Assistant Program.

PAST 441. Pre-Clinical Clerkships II. 1 Unit.
This course/clerkship provides the student with clinical experience at clinical sites in the didactic year utilizing what was learned in Foundations of Clinical Medicine (Interviewing and Physical Diagnosis class/lab). During the pre-clinical time at program designated sites, students will continue to develop and apply their history and physical exam skills, interpersonal skills, oral presentation and medical documentation skills. For expanding skills and creating relationships within the community, this course also encompasses community service, experiential learning and interprofessional education activities. This course/clerkship will help to better prepare students to gain experience and develop confidence in approaching patients prior to entering the clinical year. Prereq: Students must be in Physician Assistant Program.

PAST 450. Culture and Health. 2 Units.
This lecture/discussion course provides students with a detailed understanding of the societal and individual prejudices, preconceptions, and biases that enter into the clinical interaction and how to develop appropriate responses and coping strategies. This course provides the student with common psychosocial problems encountered by health professionals today. Students explore issues related to sexuality, cultural competency, multicultural health, cross-cultural communication, and healthcare disparities. Prereq: Students must be in Physician Assistant Program.

PAST 451. Introduction to Public Health. 1 Unit.
This course will introduce students to concepts of public health and provide experience in public health by completion of a mentored project with a local health department. The course will enhance the student’s knowledge of the history and philosophy of public health, the Healthy People 2020 initiatives and the social determinants of health and how they can be impacted. Teaching methodologies will include online modules from the Association for Prevention Teaching and Research and discussion along with the mentored public health project. Prereq: Students must be in Physician Assistant Program.

PAST 452. Introduction to Evidence Based Medicine. 2 Units.
This course is intended to provide learners with a basic understanding of the principles of epidemiology, biostatistics and evidence-based medicine. The course involves analysis of prospective and retrospective studies, cross-sectional studies and experimental epidemiology. It will focus on epidemiological scenarios that relate to both infectious disease and chronic disease. In addition, the course will provide the student with a basic understanding of the application of statistical techniques to the biological and health sciences and to demonstrate their areas of application. Emphasis will be placed on probability laws, sampling and parameter estimation, test of hypothesis, correlation, regression and analysis of variance. Finally, students will be introduced to the basic concepts of evidence-based medicine, information mastery, and critical appraisal of the medical literature. Prereq: Students must be in Physician Assistant Program.

PAST 453. Medical Spanish Elective. 1 Unit.
This course will teach students the basics of Spanish as it applies to the medical field such as physical examinations, emergencies, common diseases within the Latino population, and specializations. By familiarizing students with conversational Spanish and medical Spanish, this course will enable students to apply their learning to real-world situations, to assist in communications, and ultimately to break down the barrier between doctors and patients. Prereq: Students must be in Physician Assistant Program.

PAST 454. Research Methods Elective. 1 Unit.
This lecture course introduces students to research design and scientific inquiry and provides them with the skills necessary for interpretation and critical evaluation of the medical literature. It includes a brief review of important statistical principles and methods and their application to problems in medicine and health. Prereq: Students must be in Physician Assistant Program.

PAST 477. Human Physiology. 4 Units.
This lecture/seminar experience is meant to enhance the students fundamental knowledge in human physiology with an emphasis on physiologic concepts in relationship to health, disease and illnesses. The course will provide students with an understanding of the function, regulation and integration of the major organ systems. Offered as PAST 477 and PHOL 477. Prereq: Students must be in Physician Assistant Program.
PAST 500. Clinical Residency: Emergency Medicine Rotation. 3 Units.
This clinical rotation is designed to expose the student to the wide variety of problems encountered in the hospital-based emergency room setting in both the fast track and acute care sides of the emergency department. The rotation experience includes the medical/surgical management of patients of all ages (infant to geriatric) with presenting problems that may be of a life threatening nature. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a history and physical exam, interpretation of diagnostic testing, and the development of a plan. The student will also be exposed to and perform diagnostic and therapeutic procedures. These experiences will be under appropriate supervision. Prereq: Students must be in Physician Assistant Program.

PAST 501. Clinical Residency: Family Medicine. 3 Units.
This clinical rotation is designed to give the student an understanding of family medicine/primary care medicine as practiced in office and/or clinic in an outpatient setting. The student will work with patients from a variety of social, economic and cultural backgrounds across the lifespan. They will experience continuity of care while assessing, diagnosing, monitoring, managing, referring and educating patients. The student will be exposed to both acute and chronic problems as well as the psychosocial problems that are encountered in this setting. Students may encounter and participate in the care of patients of all ages: pediatric, adolescent, adult and geriatric populations. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Prereq: Students must be in Physician Assistant Program.

PAST 502. Clinical Residency: Geriatrics. 3 Units.
This clinical rotation is designed to give the student an understanding of geriatric medicine. The understanding of the many and varied medical and psycho-social problems in geriatric patients is accomplished via the accurate collection of data through a complete history and physical examination, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Teaching rounds and lectures may be used to introduce concepts of geriatric medicine. Prereq: Students must be in Physician Assistant Program.

PAST 503. Clinical Residency: Internal Medicine Rotation. 3 Units.
This clinical rotation is designed to provide the student with an understanding of the wide variety of problems encountered in hospital-based internal medicine. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problems. Students are assigned to medical teams during their rotation. Teaching rounds and lectures are used to introduce concepts of internal medicine. Prereq: Students must be in Physician Assistant Program.

PAST 504. Clinical Residency: Obstetrics & Gynecology. 3 Units.
This clinical rotation is designed to expose the student to the variety of problems encountered in women’s health care. The focus of the learning experience is on recognition and management of common gynecological illnesses, sexually transmitted infections, family planning, birth control, and cancer of the female reproductive system and breast. Obstetrical focus is on pregnancy, labor and delivery, and postpartum care. The student will also have an exposure to the surgical management of gynecological and obstetric problems. Teaching rounds and lectures may be used to introduce concepts of obstetrics and gynecology. Prereq: Students must be in Physician Assistant Program.

PAST 505. Clinical Residency: Pediatrics. 3 Units.
This clinical rotation is designed to emphasize care of the child from birth to adolescence. The focus of the learning experience is on recognition and management of common childhood illnesses, assessment of variations of normal growth and development, and the counseling of parents regarding immunizations, preventative health care visits, growth and development, nutrition, injury prevention and common psychosocial problems. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Teaching rounds and lectures may be used to introduce concepts of pediatrics. Prereq: Students must be in Physician Assistant Program.

PAST 506. Clinical Residency: Behavioral and Mental Health. 3 Units.
This clinical rotation is designed to give the student an understanding of the psycho-social and behavioral components of health, disease, and disability. The student will be exposed to a variety of mental illnesses and disabilities and will also be able to recognize and categorize psychiatric disorders along with the therapeutic modalities used in their treatment. The formulation and understanding of the varied psychiatric problems is accomplished via the accurate collection of data through a complete history and mental status exam, interpretation of diagnostic testing when appropriate, formulation of a problem list, and the development of a plan for each presenting problem. Emphasis is placed on early recognition, intervention, and psychiatric referral and/or consultation. Teaching rounds and lectures are used to introduce concepts of psychiatric medicine. Prereq: Students must be in Physician Assistant Program.

PAST 507. Clinical Residency: Surgery. 3 Units.
This clinical rotation is designed to expose the student to the varied population with surgically manageable disease from adolescence to geriatrics. The formulation and understanding of the varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan. The focus of the learning experience is on the pre-operative evaluation and preparation of the patients for surgery, procedures and assisting during the intra-operative period, and the care of patients post-operatively. The student will be exposed to both emergent and non-emergent surgical management of patients. The student may be assigned to surgical teams during his/her rotation. Teaching rounds and lectures are used to introduce concepts of surgical care. Prereq: Students must be in Physician Assistant Program.
PAST 508. Clinical Residency: Primary Care Elective. 3 Units.
This clinical rotation is designed to give the student an understanding of family medicine/primary care medicine as practiced in office and/or clinic in an outpatient setting. The student will work with patients from a variety of social, economic and cultural backgrounds across the lifespan. They will experience continuity of care while assessing, diagnosing, monitoring, managing, referring and educating patients. The student will be exposed to both acute and chronic problems as well as the psychosocial problems that are encountered in this setting. Students may encounter and participate in the care of patients of all ages: pediatric, adolescent, adult and geriatric populations. The formulation and understanding of the many and varied medical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Prereq: Students must be in Physician Assistant Program.

PAST 509. Clinical Residency: Inpatient Medicine Elective. 3 Units.
This clinical rotation is designed to provide the student with an understanding of the wide variety of problems encountered in hospital-based internal/surgical medicine. The formulation and understanding of the many and varied medical and/or surgical problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem. Students are assigned to medical teams during their rotation. Teaching rounds and lectures are used to introduce concepts of hospital based medicine. Prereq: Students must be in Physician Assistant Program.

PAST 510. Clinical Residency: Elective. 3 Units.
This elective clinical rotation is designed to provide the student with the knowledge and skills in an area of interest. Students will gain an understanding of the variety of problems encountered in a medical or surgical sub-specialty discipline. The formulation and understanding of the many and varied medical and/or surgical sub-specialty problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem including pharmacologic and non-pharmacologic management. Acquisition of these skills helps facilitate the PA student to progress through the clinical rotation with increasing complexity of clinical experiences, building confidence, competence and compassion. In addition to gaining clinical skills specific to the specialty of the rotation, the student will also continue to develop skills in systematic medical problem solving and patient management abilities, establish or reinforce patterns of independent learning, self-evaluation, interprofessional relationships and communication skills. Elective rotation sites are chosen based on practice characteristics that are important for the PA student within this rotation. These may include practice location, patient populations, and availability of specific experiences and procedures. Prereq: Students must be in Physician Assistant Program.

PAST 511. Clinical Residency: Elective. 3 Units.
This elective clinical rotation is designed to provide the student with the knowledge and skills in an area of interest. Students will gain an understanding of the variety of problems encountered in a medical or surgical sub-specialty discipline. The formulation and understanding of the many and varied medical and/or surgical sub-specialty problems is accomplished via the accurate collection of data through a complete history and physical exam, interpretation of diagnostic testing, formulation of a problem list, and the development of a plan for each presenting problem including pharmacologic and non-pharmacologic management. Acquisition of these skills helps facilitate the PA student to progress through the clinical rotation with increasing complexity of clinical experiences, building confidence, competence and compassion. In addition to gaining clinical skills specific to the specialty of the rotation, the student will also continue to develop skills in systematic medical problem solving and patient management abilities, establish or reinforce patterns of independent learning, self-evaluation, interprofessional relationships and communication skills. Elective rotation sites are chosen based on practice characteristics that are important for the PA student within this rotation. These may include practice location, patient populations, and availability of specific experiences and procedures. Prereq: Students must be in Physician Assistant Program.

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http://physiology.case.edu/
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Walter F. Boron, MD, PhD, Chair
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Bart Jarmusch (bbj2@case.edu), Manager of Graduate Education

The Department of Physiology and Biophysics at Case is a multidisciplinary department that takes great pride in its history of conducting research and training graduate students. The department includes 20 Primary and 33 Secondary faculty members, more than 25 post-doctoral associates, and over 300 full-time PhD, MD/PhD, and Master of Science degree students. The training programs are designed to provide a mentored training environment that maximizes faculty-student interaction.

As outlined below, the department offers PhD, MD/PhD and Master of Science degrees. These programs are tailored to prepare students for successful careers in biomedical, pharmaceutical and industrial research. The department offers multiple graduate-level programs, each of which uses state-of-the-art molecular, cell biology, and biophysical approaches to study physiological questions at a variety of different
organizational levels. The goal is to provide an outstanding training opportunity. The major goals of the PhD and Tech Masters programs are to provide students with a broad knowledge base in organ systems and integrated physiology and in-depth expertise and outstanding research potential in the fields of cellular and molecular physiology and molecular and cellular biophysics. These goals are accomplished using a series of foundation and advanced topic courses, skill development courses, laboratory rotations and thesis research. The MS in Medical Physiology program is a post-baccalaureate program designed to help students prepare for admission to medical, dental, pharmacy, or veterinary school or for opportunities to work in the biotechnology industry.

Masters Degrees
The Master’s Program in Medical Physiology is designed for students with at least a bachelor’s degree in a chemical, physical, or biological science who are seeking advanced training in the physiological sciences, typically in preparation for admission to a professional medical program (e.g. Medical School, Dental School). The program is flexible in duration. It can take as little as 1 year (2 semesters, 9 months) to complete the required 30 credit hours of course work. However, students who wish to decompress the program can take up to 14 months or more to complete the requirements. Core courses and flexible electives allow students to focus their work in key areas of medical physiology, including Anatomy, Biochemistry, or Pharmacology. Graduates of the Medical Physiology Master’s Program also can pursue careers in basic and clinical research, research administration, teaching or management in academia, the pharmaceutical and biotechnology industries, private research institutions, government science or regulatory agencies, or medicine and health care.

MS Medical Physiology - Type B Non-Thesis Option

**First Year**

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<td>Physiology and Biophysics Department Seminar for Medical Physiology Students (PHOL 498C)</td>
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<td>Medical Physiology II (PHOL 482)</td>
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<td>Translational Physiology II (PHOL 484)</td>
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<td>Independent Study (PHOL 451)</td>
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<td>On Being a Professional Scientist: The Responsible Conduct of Research (IBMS 500)</td>
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<td>Physiology MSMP Seminar B (Spring Semester) (PHOL 498B)</td>
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Total Units in Sequence: 31-48

**MD/MS Biomedical Investigation - Physiology Track**

This track offers training in physiology and biomedical laboratory technology, including emphasis on mentor independent research training which includes both laboratory experience and formal course work in modern laboratory methodology and instrumentation.

**Students in Physiology and Biotechnology track must complete:**

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<tr>
<th>Course</th>
<th>Units</th>
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<tr>
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**And 9 credits from the following course list:**

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<tr>
<td>PHOL 456 Conversations on Protein Structure and Function</td>
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<td>PHOL 466 Cell Signaling</td>
<td>3</td>
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<tr>
<td>PHOL 468 Membrane Physiology</td>
<td>3</td>
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<tr>
<td>PHOL 480 Physiology of Organ Systems</td>
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<tr>
<td>PHOL 530 Technology in Physiological Sciences</td>
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**PhD in Physiology and Biophysics**

The Physiology and Biophysics Graduate Program provides comprehensive training leading to the PhD degree and MD/PhD degrees. This program has three tracks of study with emphasis on Cell and Molecular Physiology, Structural Biology and Biophysics, and Organ Systems Physiology. Admissions to the Physiology and Biophysics program may be obtained in the integrated Biomedical Sciences Training Program.
(http://casemed.case.edu/bstp), by direct admission to the department or via the MSTP (http://mstp.case.edu/default.asp) program.

To earn a PhD in Physiology and Biophysics, a student must complete rotations in at least three laboratories followed by selection of a research advisor, and complete Core and Elective coursework including responsible conduct of research as described in the course of study, below. Students who previously completed relevant coursework, for example with a MS, may petition to complete alternative courses.

Each graduate program follows the overall regulations established and described in CWRU Graduate Studies and documented to the Regents of the State of Ohio. Completion of the PhD degree will require 36 hours of coursework (24 hours of which are graded) and 18 hours of PHOL 701 Dissertation Ph.D..

In addition, each student must successfully complete a qualifier examination for advancement to candidacy in the form of a short grant proposal with oral defense. The qualifier is generally completed in the summer after year two. During the dissertation period, students are expected to meet twice a year with the thesis committee, present seminars in the department, and fulfill journal publication requirements. At the completion of the program, successful defense of a doctoral dissertation is required. Throughout the doctoral training, students are expected to be enthusiastic participants in seminars, journal clubs, and research meetings in the lab and program.

### Plan of Study for PhD in Cell and Molecular Physiology *

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| Total Units in Sequence: | 29-61 |

* After passing qualifying exam - full-time thesis research (701) - 18 total credit hours total

### Plan of Study for PhD in Structural Biology and Biophysics *

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## Program of Study for PhD in Organ Systems and Integrated Physiology *

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### Total Units in Sequence

| 26-58 |

* After passing qualifying exam - full-time thesis research (701) - 18 total credit hours total

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### Courses

**PHOL 351. Independent Study. 1 - 6 Units.**
This course is a guided program of study in physiology textbooks, reviews, and original articles. Guided laboratory projects to reproduce and extend classical physiological experiments are offered to the undergraduate science major. This course is being offered in conjunction with the Graduate level course PHOL 451. Students are required to consult with the faculty member whose work they have interest in and plan their individual experience.

**PHOL 401A. Physiology and Biophysics of Molecules and Cells. 2 Units.**
Physiology and Biophysics of Molecules and Cells is a graduate-level introductory course designed to provide the fundamental principles of modern physiology, protein science and structural biology, and to prepare students for advanced courses in the biomedical sciences. The course is divided into 2 blocks that can be taken independently as PHOL 401A or PHOL 401B (2 credit hrs each) during the Spring semester of each year. The first block will cover the structure and function of proteins and lipids, and the organization of cellular membranes. Topics will include primary, secondary, tertiary and quaternary protein structure and analysis, enzyme kinetics, allostericity and cooperativity, lipid membrane organization and domain structure, and protein-protein and protein-lipid interactions. The second block will cover molecular pathways and processes critical for cellular homeostasis, function, and signaling. Topics will include molecular mechanisms of transport across biological membranes and cellular compartments, ionic basis of the resting membrane potential, action potential generation and propagation, osmosis and Gibb-Donnan equilibria, regulation of voltage-gated channels and electronegic transporters, cellular pH regulation, and the biophysics of epithelial transport. Format will be a combination of lecture, discussion-based problem sets, journal paper presentations, and computer lab exercises and demonstrations. Grading will be based on performance on two essay-type exams administered in the middle and at the end of each block (80%), and on class participation (20%).
PHOL 401B. Physiology and Biophysics of Molecules and Cells. 2 Units. Physiology and Biophysics of Molecules and Cells is a graduate-level introductory course designed to provide the fundamental principles of modern physiology, protein science and structural biology, and to prepare students for advanced courses in the biomedical sciences. The course is divided into 2 blocks that can be taken independently as PHOL 401A or PHOL 401B (2 credit hrs each) during the Spring semester of each year. The first block will cover the structure and function of proteins and lipids, and the organization of cellular membranes. Topics will include primary, secondary, tertiary and quaternary protein structure and analysis, enzyme kinetics, allostery and cooperativity, lipid membrane organization and domain structure, and protein-protein and protein-lipid interactions. The second block will cover molecular pathways and processes critical for cellular homeostasis, function, and signaling. Topics will include molecular mechanisms of transport across biological membranes and cellular compartments, ionic basis of the resting membrane potential, action potential generation and propagation, osmosis and Gibbs-Donnan equilibria, regulation of voltage-gated channels and electrogenic transporters, cellular pH regulation, and the biophysics of epithelial transport. Format will be a combination of lecture, discussion-based problem sets, journal paper presentations, and computer lab exercises and demonstrations. Grading will be based on performance on two essay-type exams administered in the middle and at the end of each block (80%), and on class participation (20%).

PHOL 402. Physiological Basis for Disease. 4 Units. Physiological Basis for Disease is a graduate-level introductory course designed to provide the fundamental physiology of a select group of organ systems and examples of how the molecular basis of disease affects physiological function of these systems. As such PHOL 402 will prepare students for future study in advanced biomedical sciences courses. Select diseases of the endocrine, central nervous, pulmonary, cardiac and renal systems will be covered. The course is 4 credit hours and will be given in the Fall semester of each year. The format will be a combination of lecture and journal paper presentations and discussion. Grading will be based on five short answer/essay examinations given at the end of each section (50%), class participation (20%) and a final presentation (20%).

PHOL 410. Basic Oxygen & Physiological Function. 2 Units. On-line lecture only course which explores the significance and consequences of oxygen and oxygen metabolism in living organisms. Topics to be covered include transport by blood tissues, oxygen toxicity, and mitochondrial metabolism. Emphasis will be placed on mammalian physiology with special reference to brain oxidative metabolism and blood flow as well as whole body energy expenditure and oxidative stress related to disease. The course will cover additional spans of physiology, nutrition and anatomy. Offered as NTRN 410 and PHOL 410.

PHOL 412. Membrane Transport Processes. 3 Units. Membranes and membrane transporters are absolutely required for all cells to take up nutrient, maintain membrane potential and efflux toxins. This course will consider the classification and structure of membrane transport proteins and channels, examine the common mechanistic features of all systems and the specific features of different classes of transporter. Understanding the physiological integration of transport processes into cell homeostasis and consideration of transporters and channels as drug targets will be a goal. Course format is minimal lecture, primarily student presentations of primary literature papers. Offered as PHOL 412 and PHRM 412. Prereq: CBIO 453 and CBIO 455.

PHOL 419. Applied Probability and Stochastic Processes for Biology. 3 Units. Applications of probability and stochastic processes to biological systems. Mathematical topics will include introduction to discrete and continuous probability spaces (including numerical generation of pseudo random samples from specified probability distributions), Markov processes in discrete and continuous time with discrete and continuous sample spaces, point processes including homogeneous and inhomogeneous Poisson processes and Markov chains on graphs, and diffusion processes including Brownian motion and the Ornstein-Uhlenbeck process. Biological topics will be determined by the interests of the students and the instructor. Likely topics include: stochastic ion channels, molecular motors and stochastic ratchets, actin and tubulin polymerization, random walk models for neural spike trains, bacterial chemotaxis, signaling and genetic regulatory networks, and stochastic predator-prey dynamics. The emphasis will be on practical simulation and analysis of stochastic phenomena in biological systems. Numerical methods will be developed using a combination of MATLAB, the R statistical package, MCell, and/or URDME, at the discretion of the instructor. Student projects will comprise a major part of the course. Offered as BIOL 319, EECS 319, MATH 319, SYBB 319, BIOL 419, EBME 419, MATH 419, PHOL 419, and SYBB 419.

PHOL 430. Advanced Methods in Structural Biology. 1 - 6 Units. The course is designed for graduate students who will be focusing on one or more methods of structural biology in their thesis project. This course is divided into 3-6 sections (depending on demand). The topics offered will include X-ray crystallography, nuclear magnetic resonance spectroscopy, optical spectroscopy, mass spectrometry, cryo-electron microscopy, and computational and design methods. Students can select one or more modules. Modules will be scheduled so that students can take all the offered modules in one semester. Each section is given in 5 weeks and is worth 1 credit. Each section covers one area of structural biology at an advanced level such that the student is prepared for graduate level research in that topic. Offered as BIOL 430, CHEM 430, PHOL 430, and PHRM 430.

PHOL 451. Independent Study. 1 - 18 Units. Guided program of study using physiology textbooks, research reviews, and original research articles. An independent laboratory research project may also be included.

PHOL 456. Conversations on Protein Structure and Function. 2 Units. The goal of this course is to supplement the short and basic presentation of Proteins in C3MB by lectures and discussions for students with backgrounds in physical-chemical sciences or students who already have a good basic background in protein science. The course presents an overview of Protein structure/function. Following an introduction to the principles of protein structure, the physical basis of protein folding and stability, and a brief overview of structural and bioinformatics approaches to protein analysis is presented. Typically two lecture/discussion style presentations are followed by a student lead journal club on recent high profile papers. The way the Journal club is done is that one student presents a paper (background and figures in powerpoint slides) while presentation of the main figures is shared between the class. Papers and Figures will be assigned by instructor. Typically two papers will be presented per session. Offered as PHOL 456 and BIOL 457.
PHOL 466. Cell Signaling. 3 Units.
This is an advanced lecture/journal/discussion format course that covers cell signaling mechanisms. Included are discussions of neurotransmitter-gated ion channels, growth factor receptor kinases, cytokine receptors, G protein-coupled receptors, steroid receptors, heterotrimeric G proteins, ras family GTPases, second messenger cascades, protein kinase cascades, second messenger regulation of transcription factors, microtubule-based motility, actin/myosin-based motility, signals for regulation of cell cycle, signals for regulation of apoptosis. Offered as CLBY 466, PHOL 466 and PHRM 466.

PHOL 467. Topics in Evolutionary Biology. 3 Units.
The focus for this course on a special topic of interest in evolutionary biology will vary from one offering to the next. Examples of possible topics include theories of speciation, the evolution of language, the evolution of sex, evolution and biodiversity, molecular evolution. ANAT/ANTH/EEPS/PHIL/PHOL 467/BIOL 468 will require a longer, more sophisticated term paper, and additional class presentation. Offered as ANTH 367, BIOL 368, EEPS 367, PHIL 367, ANAT 467, ANTH 467, BIOL 468, EEPS 467, PHIL 467 and PHOL 467.

PHOL 468. Membrane Physiology. 3 Units.
This student-guided discussion/journal course focuses on biological membranes. Topics discussed include thermodynamics and kinetics of membrane transport, oxidative phosphorylation and bioenergetics, electro-physiology of excitable membranes, and whole and single channel electrophysiology, homeostasis and pH regulation, volume and calcium regulation. Offered as CLBY 468 and PHOL 468.

PHOL 475. Protein Biophysics. 3 Units.
This course focuses on in-depth understanding of the molecular biophysics of proteins. Structural, thermodynamic and kinetic aspects of protein function and structure-function relationships will be considered at the advanced conceptual level. The application of these theoretical frameworks will be illustrated with examples from the literature and integration of biophysical knowledge with description at the cellular and systems level. The format consists of lectures, problem sets, and student presentations. A special emphasis will be placed on discussion of original publications. Offered as BIOG 475, CHEM 475, PHOL 475, PHRM 475, and NEUR 475.

PHOL 477. Human Physiology. 4 Units.
This lecture/seminar experience is meant to enhance the students fundamental knowledge in human physiology with an emphasis on physiologic concepts in relationship to health, disease and illnesses. The course will provide students with an understanding of the function, regulation and integration of the major organ systems. Offered as PAST 477 and PHOL 477.

PHOL 478. Lifestyle Medicine. 3 Units.
While the current acute care model of medicine focuses on disease and treatment of individual organ systems by specialists, 50-60% of the public use complementary and alternative medicine (CAM), which focuses on prevention rather than disease. In CAM, damage caused by Western diets is avoided with low fat, vegetarian, or vegan diets, and with herbs and supplements. Damage mediated by emotional responses to stress is counteracted with relaxation practices such as yoga, meditation or hypnosis. In support of CAM, NIH-funded research performed over the past decade has shown that 70-90% of chronic diseases such as obesity, atherosclerosis, and cancer result from lifestyle. Moreover, mechanisms of lifestyle-induced disease as well as mechanisms by which these can be prevented or reversed by CAM practices have been described. This course examines interrelationships between lifestyle, health and disease and influences of CAM practices in terms of physiological health. Topics include evidence that Western diets, chronic emotional stress resulting from pervasive environmental, societal, workplace, financial, or relationship issues, and changes in circadian rhythms resulting from behaviors such as not getting enough sleep or working night-shifts facilitate disease by inducing cellular events that include epigenetic modification, changes in gene expression, and decreased telomere length. Mechanisms by which CAM practices prevent or reverse these lifestyle-mediated changes are also covered. In addition, the course considers the broader issue of how economic and political pressures are forcing rapid changes in healthcare and the influence that lifestyle-based approaches is likely to have on evolving delivery models, healthcare costs, and public health policies. The course is presented over a period of 8 weeks during the summer session. It is heavily discussion-based delivered in the form of slide presentations, discussions of the literature, video segments, and experiential relaxation instructions. Grading is based on class discussion and a written discussion paper.

PHOL 479. Clinical Reasoning: Applied Medical Physiology. 3 Units.
Physicians, detectives, scientists and mechanics all use deductive reasoning with multiple hypotheses to solve problems. The primary objective of this course is to help students apply their knowledge of medical physiology to solving clinical problems. The second objective is to develop an overall view of the clinical reasoning process as a problem-solving method. This will be done primarily through problem-based case studies of patients with cardiovascular, pulmonary and renal disease. Case studies will be supplemented by video presentations of patient history and physical exam, and student-led presentations. Prereq: PHOL 482 and PHOL 484.
PHOL 480. Physiology of Organ Systems. 4 Units.
Our intent is to expand the course from the current 3 hours per week (1.5 hour on Monday and Wednesday) to 4 hours per week (1.5 hours on Monday and Wednesday plus 1 hour on Friday). Muscle structure and function, Myasthenia gravis and Sarcopenia; Central Nervous System, (Synaptic Transmission, Sensory System, Autonomic Nervous System, CNS circuits, Motor System, Neurodegenerative Diseases, Paraplegia and Nerve Compression); Cardiovascular Physiology (Regulation of Pressure and Flow; Circulation, Cardiac Cycle, Electrophysiology, Cardiac Function, Control of Cardiovascular function, Hypertension); Hemorrhage, Cardiac Hypertrophy, and Fibrillation; Respiratory Physiology (Gas Transport and Exchange, Control of Breathing, Acid/Base regulation, Cor Pulmonaris and Cystic Fibrosis, Sleep apnea and Emphysema); Renal Physiology (Glomerular Filtration, Tubular Function/transport, Glomerulonephritis, Tubulopathies); Gastro-Intestinal Physiology (Gastric motility, gastric function, pancreas and bile function, digestion and absorption, Liver Physiology, Pancreatitis, Liver Disease, andcirrhosis); Endocrine Physiology (Thyroid, Adrenal glands, endocrine pancreas, Parathyroid, calcium sensing receptor, Cushioning and diabetes, Reproductive hormones, eclampsia); Integrative Physiology (Response to exercise, fasting and feeding, aging). For all the classes, the students will receive a series of learning objectives by the instructor to help the students address and focus their attention to the key aspects of the organ physiology (and physiopathology). The evaluation of the students will continue to be based upon the students’ participation in class (60% of the grade) complemented by a midterm and a final exam (each one accounting for 20% of the final grade). Offered as BIOL 480 and PHOL 480.

PHOL 481. Medical Physiology I. 6 Units.
Physiology is the dynamic study of life. It describes the vital functions of living organisms and their organs, cells, and molecules. For some, physiology is the function of the whole person. For many practicing clinicians, physiology is the function of an individual organ system. For others, physiology may focus on the cellular principles that are common to the function of all organs and tissues. Medical physiology deals with how the human body functions, which depends on how the individual organ systems function, which in turn depends on the interactions among subcellular organelles and countless molecules. Thus, it requires an integrated understanding of events at the level of molecules, cells, and organs. Medical Physiology I is a lecture course (3, 2hr. lectures/week). It is the second of a two-part, comprehensive survey of physiology that is divided into five blocks: Block 5 covers the physiology of the urinary system; Block 6 covers the gastrointestinal system; Block 7 covers the endocrine system; Block 8 covers reproduction; and Block 9 covers the physiology of everyday life. Grading in the course will be based on performance on multiple choice/short essay examinations administered at the end of each block with each examination weighted according to the number of lectures contained in that block.

PHOL 482. Medical Physiology II. 6 Units.
Physiology is the dynamic study of life. It describes the vital functions of living organisms and their organs, cells, and molecules. For some, physiology is the function of the whole person. For many practicing clinicians, physiology is the function of an individual organ system. For others, physiology may focus on the cellular principles that are common to the function of all organs and tissues. Medical physiology deals with how the human body functions, which depends on how the individual organ systems function, which in turn depends on the interactions among subcellular organelles and countless molecules. Thus, it requires an integrated understanding of events at the level of molecules, cells, and organs. Medical Physiology II is a lecture course (3, 2hr. lectures/week). It is the second of a two-part, comprehensive survey of physiology that is divided into five blocks: Block 5 covers the physiology of the urinary system; Block 6 covers the gastrointestinal system; Block 7 covers the endocrine system; Block 8 covers reproduction; and Block 9 covers the physiology of everyday life. Grading in the course will be based on performance on multiple choice/short essay examinations administered at the end of each block with each examination weighted according to the number of lectures contained in that block.

PHOL 483. Translational Physiology I. 3 Units.
Physiology is the dynamic study of life, describing the vital functions of living organisms and their organs, cells, and molecules. For some clinicians, physiology is the function of an individual organ system. For others, it focuses on the cellular principles that are common to the function of all organs and tissues. Medical physiology deals with how the human body functions, which depends on how the individual organ systems function, which in turn depends on the interactions among subcellular organelles and countless molecules. Thus, it requires an integrated understanding of events at the level of molecules, cells, and organs. Medical Physiology I is a lecture course (3, 2 hr. lectures/week). It is the first of a two-part, comprehensive survey of physiology that is divided into four blocks: Block 1 covers the physiology of cells and molecules, signal transduction, basic electrophysiology, and muscle physiology; Block 2 covers the nervous system; Block 3 covers the cardiovascular system, and; Block 4 covers the respiratory system. Grading in the course will be based on performance on multiple choice/short essay examinations administered at the end of each block with each examination weighted according to the number of lectures contained in that block.

PHOL 484. Translational Physiology II. 3 Units.
Physiology is the dynamic study of life, describing the vital functions of living organisms and their organs, cells, and molecules. For some clinicians, physiology is the function of an individual organ system. For others, it focuses on the cellular principles that are common to the function of all organs and tissues. Medical physiology deals with how the human body functions, which depends on how the individual organ systems function, which in turn depends on the interactions among subcellular organelles and countless molecules. Thus, it requires an integrated understanding of events at the level of molecules, cells, and organs. Medical Physiology II is a lecture course (3, 2hr. lectures/week). It is the second of a two-part, comprehensive survey of physiology that is divided into five blocks: Block 5 covers the physiology of the urinary system; Block 6 covers the gastrointestinal system; Block 7 covers the endocrine system; Block 8 covers reproduction; and Block 9 covers the physiology of everyday life. Grading in the course will be based on performance on multiple choice/short essay examinations administered at the end of each block with each examination weighted according to the number of lectures contained in that block.
PHOL 484. Translational Physiology II. 3 Units.
Physiology is the dynamic study of life, describing the vital functions of living organisms and their organs, cells, and molecules. For some clinicians, physiology is the function of an individual organ system. For others, it focuses on the cellular principles that are common to the function of all organs and tissues. Medical physiology deals with how the human body functions, which depends on how the individual organ systems function, which depends on how the component cells function, which in turn depends on the interactions among subcellular organelles and countless molecules. Translational Physiology II will explore examples of how the latest basic research in physiology and biophysics is being applied to the treatment of human disease. For example, while the students are studying the basic physiology of the urinary system, they will also be investigating how these principles are being applied to treat/cure human kidney disorders such as renal failure, high blood pressure, glomerular disease, etc.. Translational Physiology II is a lecture course (1, 2hr lecture/week, and 1, 1hr lecture/week) taught by clinical and basic science faculty. The 2 hour lecture will be given primarily by clinical faculty and is focused on applying physiological principles to clinical cases of pathophysiology. The 1 hour lecture will be given primarily by basic science faculty and will expose students to the process of translating fundamental basic science research to the clinic, that is bench-to-bedside. It is the second of a two-part course that follows topics being simultaneously covered in the Medical Physiology II course. It is divided into 4 blocks: Block 5 covers the physiology of the urinary system; Block 6 covers the gastrointestinal system and metabolism; Block 7 covers the endocrine system and reproduction, and, Block 8 covers the physiology of everyday life. Grading in the course will be based on performance on multiple choice examinations administered at the end of each block with each examination weighted according to the number of lectures contained in the block. Coreq: PHOL 482.

PHOL 485. Comparative & Evolutionary Physiology. 4 Units.
This course presents physiological concepts from the comparative and evolutionary perspective. Aspects of vertebrate and mammalian evolution will be considered with respect to the generation of adaptive advantages for organisms to changing environmental challenges since the Cambrian. Comparative physiological concepts include scaling, variations in nutrition, energy metabolism and work efficiency. The important influences of time, temperature, water and energy on mammalian biology will be presented. The course is a lecture based course that can be taken in person or on-line. Evaluations will be by regular quizzes, a mid-term and a final exam, all MCQ. Offered as PHOL 485 and ORIG 485.

PHOL 492. Clinical Reasoning II. 3 Units.
The objective of this course is to help students use principles of medical physiology to solve clinical problems. The second objective is to develop an overall view of clinical reasoning and improve critical thinking skills. The topics in Clinical Reasoning II are neurology, gastroenterology and endocrine/metabolic diseases. PHOL 479 Clinical Reasoning I, which covers cardiovascular, pulmonary and renal diseases, is not required. I anticipate that you will learn to: - Recognize physiologic mechanisms underlying abnormal physical findings, laboratory tests and imaging. - Use signs, symptoms, physical findings, laboratory tests and imaging to generate patient problem lists. - Develop and refine diagnostic hypotheses, i.e., differential diagnosis. - Understand the physiological basis of appropriate treatment plans. Prereq: PHOL 481.

PHOL 497. Journal Club in Structural Biology and Biophysics. 1 Unit.
Biweekly Journal club to engage faculty and students in discussion of recent high profile papers in structural biology and protein biophysics. Registered students have to present one entire seminar on an assigned paper and attend all seminars, as well as participate in discussion. Recommended Preparation: undergraduate biochemistry or equivalent.

PHOL 497A. Neurology Grand Rounds. 1 Unit.
This course is a weekly seminar series offered summer, fall, and spring semesters by the Department of Neurology at University Hospitals Case Medical Center. To earn a Passing grade in this course, students must attend at least 75% of the grand rounds offered by the Department of Neurology during the semester (signing in at the session) and submit to the course director within the week following the Grand Rounds, a one page report containing: 1) the name of the presenter and their professional affiliation; 2) the title of the presentation; 3) time and place of the Grand Rounds; 4) a one paragraph synopsis of the content of the presentation. Recommended Preparation: Pass the NBME Subject Exam in Physiology and Neurophysiology. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A and PHOL 498B.

PHOL 497B. Neurology Grand Rounds. 1 Unit.
This course is a weekly seminar series offered summer, fall, and spring semesters by the Department of Neurology at University Hospitals Case Medical Center. To earn a Passing grade in this course, students must attend at least 75% of the grand rounds offered by the Department of Neurology during the semester (signing in at the session) and submit to the course director within the week following the Grand Rounds, a one page report containing: 1) the name of the presenter and their professional affiliation; 2) the title of the presentation; 3) time and place of the Grand Rounds; 4) a one paragraph synopsis of the content of the presentation. Recommended Preparation: Pass the NBME Subject Exam in Physiology and Neurophysiology. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 497A, PHOL 498A and PHOL 498B.

PHOL 497C. Clinical Nephrology Conference. 1 Unit.
Clinical Nephrology Conference (CNC) at MetroHealth Medical Center, Dept. Medicine, Division of Nephrology. This course must be taken at least once and can be taken up to 2 times for a total of 2 credit hours. For the 15-week semester, students are responsible for attending and reporting on 12 of the scheduled CNC. For each CNC, the student must submit to the course director (Dr. Liedtke) within the week following the CNC, a one page report stating: a. The name of the presenter and their professional affiliation b. The title of the presentation c. Time and place of the CNC d. A one paragraph synopsis of the content of the presentation. Recommended Preparation: Pass the NBME Subject Exam in Physiology and Neurophysiology. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 497A, PHOL 498A and PHOL 498B.

PHOL 497D. Clinical Nephrology Conference. 1 Unit.
Clinical Nephrology Conference (CNC) at MetroHealth Medical Center, Dept. Medicine, Division of Nephrology. This course must be taken at least once and can be taken up to 2 times for a total of 2 credit hours. For the 15-week semester, students are responsible for attending and reporting on 12 of the scheduled CNC. For each CNC, the student must submit to the course director (Dr. Liedtke) within the week following the CNC, a one page report stating: a. The name of the presenter and their professional affiliation b. The title of the presentation c. Time and place of the CNC d. A one paragraph synopsis of the content of the presentation. Recommended Preparation: Pass the NBME Subject Exam in Physiology and Neurophysiology. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 497A, PHOL 498A and PHOL 498B.

PHOL 497E. Clinical Nephrology Conference. 1 Unit.
Clinical Nephrology Conference (CNC) at MetroHealth Medical Center, Dept. Medicine, Division of Nephrology. This course must be taken at least once and can be taken up to 2 times for a total of 2 credit hours. For the 15-week semester, students are responsible for attending and reporting on 12 of the scheduled CNC. For each CNC, the student must submit to the course director (Dr. Liedtke) within the week following the CNC, a one page report stating: a. The name of the presenter and their professional affiliation b. The title of the presentation c. Time and place of the CNC d. A one paragraph synopsis of the presentation The course director is responsible for assigning the grades for this course. Prior or concurrent CITI training must be completed. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 497A, PHOL 498A and PHOL 498B.

PHOL 497F. Clinical Nephrology Conference. 1 Unit.
Clinical Nephrology Conference (CNC) at MetroHealth Medical Center, Dept. Medicine, Division of Nephrology. This course must be taken at least once and can be taken up to 2 times for a total of 2 credit hours. For the 15-week semester, students are responsible for attending and reporting on 12 of the scheduled CNC. For each CNC, the student must submit to the course director (Dr. Liedtke) within the week following the CNC, a one page report stating: a. The name of the presenter and their professional affiliation b. The title of the presentation c. Time and place of the CNC d. A one paragraph synopsis of the presentation The course director is responsible for assigning the grades for this course. Prior or concurrent CITI training must be completed. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 497A, PHOL 498A and PHOL 498B.
PHOL 497E. Pulmonary Grand Rounds. 1 Unit.
Students are responsible for attending 10 of 15 sessions for that semester. Pulmonary Science Grand Rounds (adult pulmonology) and Pediatric Basic Science Seminar Series are convened Friday mornings at UH Case Medical Center at 8:00 am and 9:00 am, respectively. For each session attended, the student must submit to the course director (Dr. Liedtke) within the week following the session, a one page report stating: a. name of the presenter and their professional affiliation, b. title of the presentation, c. time and place of the session, and d. one paragraph synopsis of the presentation. The course director is responsible for assigning the grades for this course. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, and PHOL 498B.

PHOL 497F. Pulmonary Grand Rounds. 1 Unit.
This course must be taken once and can be taken up to 2 times for a total of 2 credit hours. Students are responsible for attending 10 of 15 sessions for that semester. Pulmonary Science Grand Rounds (adult pulmonology) and Pediatric Basic Science Seminar Series are convened Friday mornings at UH Case Medical Center at 8:00 am and 9:00 am, respectively. For each session attended, the student must submit to the course director (Dr. Liedtke) within the week following the session, a one page report stating: a. name of the presenter and their professional affiliation, b. title of the presentation, c. time and place of the session, and d. one paragraph synopsis of the presentation. The course director is responsible for assigning the grades for this course. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, and PHOL 498B.

PHOL 498A. Physiology and Biophysics Departmental Seminar. 1 Unit.
Weekly one-hour reviews by invited speakers of their research. Students present literature reviews or summaries of their research.

PHOL 498B. Physiology Seminar B (Spring Semester). 1 Unit.
Weekly one-hour reviews by invited speakers of their research. Offered spring semester.

PHOL 498C. Physiology and Biophysics Department Seminar for Medical Physiology Students. 1 Unit.
Weekly one-hour research reviews offered by various speakers, upon invitation. Students present literature reviews or summaries of their own research throughout the course. Grades will be determined by quizzes based on the research presented.

PHOL 498D. Physiology MSMP Seminar B (Spring Semester). 1 Unit.
Weekly one-hour research reviews offered by various speakers, upon invitation. Students present literature reviews or summaries of their own research throughout the course. Grades will be determined by quizzes based on the research presented. Offered spring semester.

PHOL 505. Laboratory Research Rotation. 1 Unit.
Six week experience in a selected faculty research laboratory designed to introduce the student to all aspects of modern laboratory research including the design, execution and analysis of original experimental work. Recommended preparation: Consent of instructor and scheduled laboratory.

PHOL 513. Structural Journal Club. 1 Unit.
Current topics of interest in structural biology, and protein biophysics. Offered as PHOL 513 and PHRM 513.

PHOL 514. Cardiovascular Physiology. 3 Units.
The goal of this course is to provide the student with a solid foundation in cardiovascular physiology and pathophysiology. The course will begin by providing a solid foundation in the structure, phenotype and function of cardiac and vascular muscle. In addition, electrophysiology and metabolism will be addressed. Both basic physiology and more advanced topics, such as pathophysiology, will be covered using a journal club format. (Twice weekly; 1.5hrs/class.) Student participation is required.

PHOL 519. Cardio-Respiratory Physiology. 3 Units.
This course is designed to integrate systemic, cellular and molecular aspects of cardio-respiratory systems in physiological and pathophysiological states. The course requires prior knowledge of basic physiology of the cardiovascular systems. Extensive student participation is required. Instructors provide a brief overview of the topic followed by presentation and critical appraisal of recent scientific literature by students.

PHOL 528. Contemporary Approaches to Drug Discovery. 3 Units.
This course is designed to teach the students how lead compounds are discovered, optimized, and processed through clinical trials for FDA approval. Topics will include: medicinal chemistry, parallel synthesis, drug delivery and devices, drug administration and pharmacokinetics, and clinical trials. A special emphasis will be placed on describing how structural biology is used for in silico screening and lead optimization. This component will include hands-on experience in using sophisticated drug discovery software to conduct in silico screening and the development of drug libraries. Each student will conduct a course project involving in silico screening and lead optimization against known drug targets, followed by the drafting of an inventory disclosure. Another important aspect of this course will be inclusion of guest lectures by industrial leaders who describe examples of success stories of drug development. Offered as BIOC 528, PHOL 528, PHRM 528, and SYBB 528.

PHOL 530. Technology in Physiological Sciences. 3 Units.
This lecture/discussion/journal course focuses on techniques in the physiological sciences. Topics include spectroscopy, microscopy, and electrophysiology. The theory and practice are covered with an emphasis on examples taken from the scientific literature.

PHOL 537. Microscopy-Principles and Applications. 3 Units.
This course provides an introduction to various types of light microscopy, digital and video imaging techniques, and their applications to biological and biomedical sciences via lectures and hands-on experience. Topics covered include geometrical and physical optics; brightfield, darkfield, phase contrast, DIC, fluorescence and confocal microscopes; and digital image processing. Offered as GENE 537, MBIO 537, and PHOL 537.

PHOL 601. Research. 1 - 18 Units.
Cellular physiology laboratory research activities that are based on faculty and student interests.

PHOL 610. Oxygen and Physiological Function. 3 Units.
Lecture/discussion course which explores the significance and consequences of oxygen and oxygen metabolism in living organisms. Topics to be covered include oxygen transport by blood tissues, oxygen toxicity, and mitochondrial metabolism. Emphasis will be placed on mammalian physiology with special reference to brain oxidative metabolism and blood flow as well as whole body energy expenditure and oxidative stress related to disease. The course will cover additional spans of physiology, nutrition and anatomy. Offered as ANAT 610, NTRN 610, and PHOL 610.
PHOL 614. Sleep Physiology - Neurobiology of Sleep/Wake. 3 Units.
Participants in this course will gain an understanding of the neural mechanisms contributing to the states of sleep and wakefulness. Contemporary theories regarding why humans need to sleep will be reviewed. We will also review how perturbations within specific neurotransmitter systems become manifest as sleep related disorders and the pharmacological interventions used to normalize activity within those neural pathways. Prereq: PHOL 481 and PHOL 482 or requisites not met permission.

PHOL 620A. Clinical Observer: Neurology Service. 2 Units.
This course is a 2 week intensive experience offered summer, fall, and spring semesters on a schedule set by the Department of Neurology at University Hospitals Case Medical Center. Students are expected to be present and observe at all of the times set forth by the house staff and attending, generally a 40 hour week minimum. The Objective of the course is to provide the students with the experience of observing patient care provided by 3rd year medical students on a clinical rotation under direct supervision by house staff and attending on an active acute Neurology Service. The PGY-2 Neurology Resident and PGY-3 Chief Resident will always be available for immediate supervision. Students round as Clinical Observers with the CWRU medical students according to their daily schedule. They will learn the basics of neurological history-taking, neurological examination, neurodiagnostic studies, and neurological therapeutics. Didactic sessions covering a wide range of neurologic and neurosurgical topics are covered by faculty members from both departments. The lectures cover the gamut of neurological and neurosurgical disease processes and treatments. Neurosurgery lectures include such topics as cerebrovascular disease, brain tumors, hydrocephalus, spinal disorders, and head trauma as well as doctor-patient communication. Unlike the medical students on the rotation, a Clinical Observer will only observe procedures and will not actively take part in any health care; he/she will act strictly as an observer, but will act as a physiological consultant to the team responsible for providing basic science input to the clinical cases. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, and PHOL 498B.

PHOL 620B. Clinical Observer: Stroke Service. 2 Units.
This course is a 2 week intensive experience offered summer, fall, and spring semesters on a schedule set by the Department of Neurology at University Hospitals Case Medical Center. Students are expected to be present and observe at all of the times set forth by the house staff and attending, generally a 40 hour week minimum. The Objective of the course is to provide the students with the experience of observing patient care provided by 3rd year medical students on a clinical rotation under direct supervision by house staff and attending on an active acute Neurology Service. The PGY-2 Neurology Resident and PGY-3 Chief Resident will always be available for immediate supervision. Students round as Clinical Observers with the CWRU medical students according to their daily schedule. They will learn the basics of neurological history-taking, neurological examination, neurodiagnostic studies, and neurological therapeutics. Didactic sessions covering a wide range of neurologic and neurosurgical topics are covered by faculty members from both departments. The lectures cover the gamut of neurological and neurosurgical disease processes and treatments. Neurosurgery lectures include such topics as cerebrovascular disease, brain tumors, hydrocephalus, spinal disorders, and head trauma as well as doctor-patient communication. Unlike the medical students on the rotation, a Clinical Observer will only observe procedures and will not actively take part in any health care; he/she will act strictly as an observer, but will act as a physiological consultant to the team responsible for providing basic science input to the clinical cases. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, and PHOL 498B.

PHOL 620C. Clinical Observer: Epilepsy Service. 2 Units.
This course is a 2 week intensive experience offered summer, fall, and spring semesters on a schedule set by the Department of Neurology at University Hospitals Case Medical Center. Students are expected to be present and observe at all of the times set forth by the house staff and attending, generally a 40 hour week minimum. The Objective of the course is to provide the students with the experience of observing patient care provided by 3rd year medical students on a clinical rotation under direct supervision by house staff and attending on an active acute Neurology Service. The PGY-2 Neurology Resident and PGY-3 Chief Resident will always be available for immediate supervision. Students round as Clinical Observers with the CWRU medical students according to their daily schedule. They will learn the basics of neurological history-taking, neurological examination, neurodiagnostic studies, and neurological therapeutics. Didactic sessions covering a wide range of neurologic and neurosurgical topics are covered by faculty members from both departments. The lectures cover the gamut of neurological and neurosurgical disease processes and treatments. Neurosurgery lectures include such topics as cerebrovascular disease, brain tumors, hydrocephalus, spinal disorders, and head trauma as well as doctor-patient communication. Unlike the medical students on the rotation, a Clinical Observer will only observe procedures and will not actively take part in any health care; he/she will act strictly as an observer, but will act as a physiological consultant to the team responsible for providing basic science input to the clinical cases. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, and PHOL 498B.

PHOL 620D. Clinical Observer: Neurology (Neuromuscular). 2 Units.
This course is a 2 week intensive experience offered summer, fall, and spring semesters on a schedule set by the Department of Neurology at University Hospitals Case Medical Center. Students are expected to be present and observe at all of the times set forth by the house staff and attending, generally a 40 hour week minimum. The Objective of the course is to provide the students with the experience of observing patient care provided by 3rd year medical students on a clinical rotation under direct supervision by house staff and attending on an active acute Neurology Service. The PGY-2 Neurology Resident and PGY-3 Chief Resident will always be available for immediate supervision. Students round as Clinical Observers with the CWRU medical students according to their daily schedule. They will learn the basics of neurological history-taking, neurological examination, neurodiagnostic studies, and neurological therapeutics. Didactic sessions covering a wide range of neurologic and neurosurgical topics are covered by faculty members from both departments. The lectures cover the gamut of neurological and neurosurgical disease processes and treatments. Neurosurgery lectures include such topics as cerebrovascular disease, brain tumors, hydrocephalus, spinal disorders, and head trauma as well as doctor-patient communication. Unlike the medical students on the rotation, a Clinical Observer will only observe procedures and will not actively take part in any health care; he/she will act strictly as an observer, but will act as a physiological consultant to the team responsible for providing basic science input to the clinical cases. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A and PHOL 498B.
PHOL 621. Clinical Nephrology Observer. 4 Units.
This course is a total of 4 week intensive experience offered on the School of Medicine elective schedule. Students will round with fellow and Medicine residents rotating during the elective on a daily basis starting with morning work rounds. Attending rounds generally begin in the afternoon. The student is restricted to a total of 15 hrs/week on clinical rounds. The student is expected to read appropriate or assigned text, journal and internet resources for necessary background reading; the time spent on these resources do not count toward the 15 hrs/week for rounds. The fellow or attending physician on the service will recommend to the course director (Dr. Liedtke) whether the student earned a Pass or Fail in the course based upon attendance, professional demeanor, active participation, and knowledge of the area. The course director is responsible for assigning the grades for this course. CITI training must be completed prior to enrollment. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, PHOL 498B.

PHOL 622. Pediatric Pulmonology Observation. 2 Units.
Pediatric Pulmonology Observation (must be approved). 2 credit hours. Location: University Hospital, Rainbow Babies & Children Hospital. This course is an intensive experience with 2 weeks offered on the elective schedule detailed in Appendix A and 1 week with attending physician reading PFTs. For 2 weeks, students will round with attending staff and medical students according to their daily schedule at Rainbow Babies & Children Hospital, Pulmonary Division, starting with morning work rounds. Attending rounds generally begin in the afternoon. The student will not have direct patient contact. The student is expected to read appropriate or assigned text, journal and internet resources for necessary background reading. Students will journal their daily experience. Students will write a paper relating basic physiology to a case identified during rounds; the Director (Dr. Liedtke) will grade the paper. The attending physician on the service will recommend to the course director (Dr. Liedtke) based upon attendance, professional demeanor, active participation, and knowledge of the area. The course director is responsible for assigning the grades for this course. Dr. Ross Meyers will serve as the student’s mentor and assign students to services. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, and PHOL498B.

PHOL 623. Adult Pulmonology Observation. 2 Units.
Adult Pulmonology AOC (must be approved). 2 credit hours. Location: University Hospital and VA Hospital. This course is an intensive experience with 2 weeks offered on the elective schedule detailed in Appendix A and 1 week with attending physician reading PFTs to evaluate 25 adult PFT, 6 exercise tests, and 6 methacholine challenges. For 2 weeks, students will round with attending staff and medical students according to their daily schedule at University Hospital starting with morning work rounds. Attending rounds generally begin in the afternoon. The student will not have direct patient contact. The student is expected to read appropriate or assigned text, journal and internet resources for necessary background reading. Students will journal their daily experience. Students will write a paper relating basic physiology to a case identified during rounds; the Director (Dr. Liedtke) will grade the paper. The attending physician on the service will recommend to the course director (Dr. Liedtke) based upon attendance, professional demeanor, active participation, and knowledge of the area. The course director is responsible for assigning the grades for this course. Dr. (TBN) will serve as the student’s mentor and assign students to services. Prereq: PHOL 481, PHOL 482, PHOL 483, PHOL 484, PHOL 498A, and PHOL 498B.

PHOL 651. Thesis M.S.. 1 - 18 Units.
PHOL 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.
Statistics is the science of data and a discipline that provides tools for making decisions under conditions of uncertainty. Biostatistics addresses all aspects of statistics that arise from medical and health-related sciences, and is an essential component of most medical, biological, and health care. The study of biostatistics includes design and analysis of both experimental studies, such as clinical trials, and observational studies; the theory of probability and statistics; mathematical and statistical modeling; and knowledge of the methodology used to evaluate the properties of statistical procedures. It also includes a competency in computing, which encompasses programming, statistical software use, and database management. Modern Biostatistics is a dynamic field of study and an integral part of medical and public health research. Those who earn the MS in Biostatistics are equipped for careers in government, industry and academic research centers or to enter doctoral programs in biostatistics.

There are four tracks our students can choose from: Biostatistics, Genomics & Bioinformatics, Health Care Analytics, and Social & Behavioral Science.

The mission of the Masters Program in Biostatistics is to enroll and train outstanding students in the core discipline of biostatistics. The faculty and students in this program are committed to teaching and learning the theory, methodology and application of the essential and modern statistical methods used in the biomedical and related sciences.

Core Courses for this Program:

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<th>Course</th>
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<tr>
<td>PQHS 414</td>
<td>Data Management and Statistical Programming</td>
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<tr>
<td>PQHS 431</td>
<td>Statistical Methods I</td>
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<td>PQHS 432</td>
<td>Statistical Methods II</td>
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<td>PQHS 453</td>
<td>Categorical Data Analysis</td>
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<td>PQHS 490</td>
<td>Epidemiology: Introduction to Theory and Methods</td>
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<td>PQHS 602</td>
<td>Practicum (Internship/Practicum)</td>
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<td>Practicum (Introduction to Biostatistical Consulting)</td>
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Biostatistics Track:

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<tr>
<td>PQHS 480</td>
<td>Introduction to Mathematical Statistics</td>
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<td>PQHS 459</td>
<td>Longitudinal Data Analysis</td>
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<td>PQHS 471</td>
<td>Machine Learning &amp; Data Mining</td>
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<td>STAT 426</td>
<td>Multivariate Analysis and Data Mining</td>
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Genomics and Bioinformatics Track:

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<tr>
<td>PQHS 471</td>
<td>Machine Learning &amp; Data Mining</td>
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<tr>
<td>PQHS 451</td>
<td>A Data-Driven Introduction to Genomics and Human Health</td>
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<td>PQHS 452</td>
<td>Statistical Methods for Genetic Epidemiology</td>
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Health Care Analytics:

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<td>PQHS 515</td>
<td>Secondary Analysis of Large Health Care Bases</td>
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<td>PQHS 459</td>
<td>Longitudinal Data Analysis</td>
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<td>PQHS 500</td>
<td>Design and Analysis of Observational Studies</td>
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<td>PQHS 450</td>
<td>Clinical Trials and Intervention Studies</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 471</td>
<td>Machine Learning &amp; Data Mining</td>
<td>3</td>
</tr>
</tbody>
</table>

Social and Behavioral Sciences Track:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PQHS 459</td>
<td>Longitudinal Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 482</td>
<td>Qualitative and Mixed Methods in Public Health</td>
<td>3</td>
</tr>
<tr>
<td>NURS 632</td>
<td>Advanced Statistics: Structural Equation Modeling</td>
<td>3</td>
</tr>
<tr>
<td>PSCL 412</td>
<td>Measurement of Behavior</td>
<td>3</td>
</tr>
</tbody>
</table>

Plentiful research opportunities exist within the department and numerous research centers across the university, and extend to the adjoining University Hospitals, to the nearby Cleveland Clinic, to Cleveland’s MetroHealth Medical Center, and to similar entities across the United States and internationally.

Concurrently, students will master the rigorous scientific and analytic methods necessary to be at the forefront of efforts to not only describe, but effectively evaluate and improve the population’s health, and contribute to both the society and the biostatistics profession. Student-and faculty-led seminars provide an ongoing mechanism for keeping abreast of current literature and identifying important areas of research and collaborative opportunities. The Department operates within a strong interdisciplinary framework involving faculty within the department, the school of medicine, and across the entire university, as well as leaders in health care institutions and health oriented organizations and agencies throughout the wider community.

Graduates from accredited universities and colleges will be considered for admission to the department. All applicants must satisfy both CWRU and department requirements for graduate admission. The MS program in Biostatistics consists of a 16-credit core curriculum, plus a 12 credit major and a 3 credit internship or practicum.

General Requirements

Students must satisfy the requirements of the School of Graduate Studies as stated here, as well as those outlined by the Biostatistics program. The MS program in Biostatistics offers “Plan B”, as defined by the CWRU School of Graduate Studies. For Plan B, the student must successfully submit and pass their written internship/practicum project.

Minor in Public Health

Questions and Information:
Nickalaus Koziura, Ed.M.

Undergraduate Minor in Public Health
Case Western Reserve University
10900 Euclid Avenue, W-G74
Cleveland, Ohio 44106-4945
216.368.3128 - phone
216.368.2286 - fax
nickalaus.koziura@case.edu (drabousky@case.edu)

The impact of public health and the need for the general public to know more is periodically highlighted during crises such as epidemics and pandemics like Zika, Ebola, and Avian Flu. Education in public health is not only necessary for those entering the public health workforce, but is a critical complementary subject for all those considering a career in a health related field.

The Undergraduate Minor in Public Health is a 15 credit program that exposes students to the field of public health. This minor is designed to equip students with the core concepts of Public Health and is highly collaborative with many departments to provide a robust option for students who are pre-health or pursuing medical anthropology, medical sociology, mental health, global health, or nutrition and health promotion.

Required Courses (9 Credits):

MPHP 101 Introduction to Public Health 3
MPHP 301 Introduction to Epidemiology 3
One of the following courses in Global Health
INTH 301 Fundamentals of Global Health 3
ANTH 359 Introduction to International Health 3

Electives (6 credits from one of the following areas):

Global Health

INTH 301 Fundamentals of Global Health 3
BETH 315B International Bioethics Policy and Practice: Public Health in the Netherlands 3
ANTH 359 Introduction to International Health 3
ANTH 354 Health and Healing in East Asia 3
ANTH 323 AIDS: Epidemiology, Biology, and Culture 3
BIOL 352 Ecology and Evolution of Infectious Diseases 3

Medical Anthropology

ANTH 354 Health and Healing in East Asia 3
ANTH 326 Power, Illness, and Inequality: The Political Economy of Health 3
ANTH 328 Medical Anthropology and Public Health 3
ANTH 338 Maternal Health: Anthropological Perspectives on Reproductive Practices and Health Policy 3
ANTH 359 Introduction to International Health 3

Medical Sociology

SOCI 264 Body, Culture and Disability 3
SOCI 311 Health, Illness, and Social Behavior 3
SOCI 344 Health Disparities 3
SOCI 345 Sociology of Mental Illness 3
SOCI 365 Health Care Delivery 3

Mental Health

PSCL 315 Social Psychology 3
PSCL 317 Health Psychology 3
PSCL 321 Abnormal Psychology 3
PSCL 344 Developmental Psychopathology 3
SOCI 345 Sociology of Mental Illness 3

Nutrition and Health Promotion

NTRN 341 Food as Medicine: How what we eat influences how we feel, think, and our health status 3
NTRN 343 Dietary Patterns 3
NTRN 328 Child Nutrition, Development and Health 3

MPHP 313 Health Education, Communication, and Advocacy 3

Master of Public Health (MPH)

Questions and Information:

Lisa Miller, MA, CHES

Master of Public Health Program
Case Western Reserve University
10900 Euclid Avenue, W-G74
Cleveland, Ohio 44106-4945
216.368.3128 - phone
216.368.2286 - fax
lxm384@case.edu (drabousky@case.edu)

A Master of Public Health degree is designed to prepare students to address the broad mission of public health, defined as “enhancing health in human populations, through organized community effort,” utilizing education, research and community service. Public health practitioners are prepared to identify and assess the health needs of different populations, and then to plan, implement and evaluate programs to meet those needs. It is the task of the public health practitioner to protect and promote the wellness of humankind. The master of public health program prepares students to enhance health in human populations through organized community effort. Graduates are qualified to work in local and state health departments, universities and colleges, hospitals, ambulatory medical centers, non-profit organizations, and the insurance and pharmaceutical industries. The program seeks to attract a rich mix of students, including those pursuing degrees in medicine, nursing, dentistry, law, social work, anthropology, bioethics, management and other fields, as well as students holding undergraduate degrees.

The CWRU MPH Program has a two-year curriculum requiring 42 credit hours. Twenty-one credits are accumulated in seven core required courses, representing the fundamental domains of public health: biostatistics, epidemiology, environmental health sciences, health services administration, public health history and social and behavioral sciences. Students receive nine credits for three courses in the major of their choice, three credits for one elective course, and nine credits for the
“Culminating Experience,” a 3 credit public health field practicum and a 6 credit capstone project. Previous experience or education pertaining to public health may increase the student’s flexibility in course selection. Students may also enroll part-time and take courses over a three to five year period.

**Requirements: Course List**

Core required courses (21 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPHP 403</td>
<td>Research &amp; Evaluation Methods</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 405</td>
<td>Statistical Methods in Public Health</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 406</td>
<td>History and Philosophy of Public Health</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 411</td>
<td>Introduction to Health Behavior</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 429</td>
<td>Introduction to Environmental Health</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 439</td>
<td>Public Health Management and Policy</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 483</td>
<td>Introduction to Epidemiology for Public Health Practice</td>
<td>3</td>
</tr>
</tbody>
</table>

Culminating Experience

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPHP 652</td>
<td>Public Health Capstone Experience</td>
<td>6</td>
</tr>
<tr>
<td>MPHP 650</td>
<td>Public Health Practicum</td>
<td>3</td>
</tr>
<tr>
<td>Complete 9 credits within chosen major ²</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units 42

¹ Students in the Population Health Research major should strongly consider taking MPHP 431 Statistical Methods I in place of MPHP 405.

² Choices for major are Population Health Research, Global Health, Health Policy & Administration, Health Promotion and Disease Prevention, or Health Informatics.

**MPH Sample Plan of Study (full-time):**

**First Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Research &amp; Evaluation Methods</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>History and Philosophy of Public Health</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to Health Behavior</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to Epidemiology for Public Health Practice</td>
<td>3</td>
</tr>
<tr>
<td>Major course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Statistical Methods in Public Health</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Introduction to Environmental Health</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Public Health Management and Policy</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Year Total: 12 12

**Second Year**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major course</td>
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<td>3</td>
</tr>
<tr>
<td>Major course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Elective course</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Public Health Practicum (MPHP 650) (Public Health Capstone Experience)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Public Health Capstone Experience (MPHP 652) (Public Health Capstone Experience) 3

**Total Units in Sequence:** 42

**Concentrations**

Currently, five different concentrations (a.k.a. tracks) are offered by the CWRU MPH Program: Population Health Research, Global Health, Health Policy & Administration, Health Promotion & Disease Prevention, and Health Informatics. Each concentration has a required course or courses (in addition to the core required courses), plus selective offerings to be combined for a total of 9 credit hours in major coursework.

Students develop a Capstone project relevant to the concentration area to expand and apply the knowledge of the subject. Individual emphasis will differ from student to student within each concentration.

MPH students can also choose to expand the emphasis and depth of their program of study by electing to do a double concentration plan of study. For the double concentration, the student chooses two areas (two concentrations) of equal emphasis and takes 3 courses in each area (this requires the student to take a minimum of 48 credit hours). The student’s Capstone project must embrace and integrate both emphases, and no double-counting of credits can take place. Students choosing to do the double concentration plan of study should also work closely with an advisor to ensure optimal course selection and foster the evolution of a successful Capstone project.

**Population Health Research Concentration**

Coordinator - Mendel Singer, PhD, MPH

**Learning Objectives:**

- Working knowledge of epidemiologic principles, terminology, and tools
- Working knowledge of the primary analytic methods employed in both prospective and retrospective studies relating to population health and/or clinical research
- Understand the most common study designs used in public health research
- Gain familiarity with some of the key advanced concepts in one of the subspecialties of population health (e.g. epidemiology, health services research, outcomes research)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPHP 421</td>
<td>Health Economics and Strategy</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 432</td>
<td>Statistical Methods II</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 450</td>
<td>Clinical Trials and Intervention Studies</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 465</td>
<td>Design and Measurement in Population Health Sciences</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 467</td>
<td>Comparative and Cost Effectiveness Research (Section 100)</td>
<td>1</td>
</tr>
<tr>
<td>MPHP 467</td>
<td>Comparative and Cost Effectiveness Research (Section 101)</td>
<td>1</td>
</tr>
<tr>
<td>MPHP 467</td>
<td>Comparative and Cost Effectiveness Research (Section 102)</td>
<td>1</td>
</tr>
<tr>
<td>MPHP 484</td>
<td>Global Health Epidemiology</td>
<td>1 - 3</td>
</tr>
<tr>
<td>PQHS 414</td>
<td>Data Management and Statistical Programming</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>PQHS 451</td>
<td>A Data-Driven Introduction to Genomics and Human Health</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 452</td>
<td>Statistical Methods for Genetic Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 459</td>
<td>Longitudinal Data Analysis</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 515</td>
<td>Secondary Analysis of Large Health Care Databases</td>
<td>3</td>
</tr>
<tr>
<td>NURS 631</td>
<td>Advanced Statistics: Multivariate Analysis</td>
<td>3</td>
</tr>
<tr>
<td>NURS 632</td>
<td>Advanced Statistics: Structural Equation Modeling</td>
<td>3</td>
</tr>
</tbody>
</table>

**Global Health Concentration**

**Coordinator - Daniel Tisch, PhD, MPH**

**Learning Objectives:**

- Develop a global perspective on health and diseases
- Learn to design, execute, analyze, and evaluate global health research or projects
- Acquire skills to understanding and communicate meaningfully with colleagues from distant fields of global health
- Learn to integrate multiple objectives in global health across academic and applied disciplines
- Understand ethical and regulatory issues for global health research

Select two out of the following three courses as required major courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTH 401</td>
<td>Fundamentals of Global Health</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 447</td>
<td>Global Health: Outbreak Investigation in Real-Time</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 484</td>
<td>Global Health Epidemiology</td>
<td>1-3</td>
</tr>
</tbody>
</table>

Select remaining major course from below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPHP 467</td>
<td>Comparative and Cost Effectiveness Research</td>
<td>1</td>
</tr>
<tr>
<td>MPHP 475</td>
<td>Management of Disasters Due to Nature, War, or Terror</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 510</td>
<td>Health Disparities</td>
<td>3</td>
</tr>
<tr>
<td>MPH 532</td>
<td>Health Care Information Systems</td>
<td>3</td>
</tr>
<tr>
<td>POSC 483</td>
<td>Health Policy and Politics in the United States</td>
<td>3</td>
</tr>
<tr>
<td>HSMC 420</td>
<td>Health Finance</td>
<td>3</td>
</tr>
<tr>
<td>LAWS 5205</td>
<td>Public Health Law</td>
<td>2</td>
</tr>
<tr>
<td>BETH 417</td>
<td>Introduction to Public Health Ethics</td>
<td>3</td>
</tr>
</tbody>
</table>

**Health Informatics Concentration**

**Coordinator - Siran Koroukian, PhD**

**Learning Objectives:**

- Understand how clinical data are collected and coded
- Aggregate, normalize, and integrate clinical and/or claims data originating from disparate forms
- Understand standard health data exchange formats and vocabularies, including Health Level 7 (HL7, designed to transfer clinical and administrative data across different applications), the Logical Observation Identifiers Names and Codes (LOINC, for encoding laboratory test and result information), the Systematized Nomenclature of Medicine (SNOMED, clinical terminology designated as a US standard for electronic health information exchange).
- Understand the ethical, regulatory, and practical aspects of data security
- Know how to retrieve and use data from social media/mobile health

Select remaining major courses from the list below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PQHS 432</td>
<td>Statistical Methods II</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 532</td>
<td>Health Care Information Systems</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 515</td>
<td>Secondary Analysis of Large Health Care Databases</td>
<td>3</td>
</tr>
<tr>
<td>EECS 480M</td>
<td>Introduction to Medical Informatics</td>
<td>3</td>
</tr>
<tr>
<td>EECS 480O</td>
<td>Introduction to Health Information Technology Implementation</td>
<td>3</td>
</tr>
<tr>
<td>IIME 473</td>
<td>Fundamentals of Clinical Information Systems</td>
<td>3</td>
</tr>
</tbody>
</table>
NUND 510  Application of Health Information Technology and Systems  1
HSMC 446  Models of Health Care Systems  1.5
HSMC 457  Health Decision Making & Analytics  3

**Health Promotion & Disease Prevention Concentration**
Coordinator - Erika Trapl, PhD

**Learning Objectives:**
- Describe models and theories of health behavior as they relate to health promotion and disease prevention
- Identify multi-factorial causes of health behavior and disease
- Demonstrate knowledge and skills necessary to support behavior change
- Apply principles and practice of effective health communication
- Describe development, implementation, and evaluation of programs that promote healthy lifestyle and behaviors

**Required major course:**
MPHP 433  Community Interventions and Program Evaluation  3

Select remaining major courses from the list below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPHP 413</td>
<td>Health Education, Communication, and Advocacy</td>
<td>3</td>
</tr>
<tr>
<td>PQHS 423</td>
<td>Dissemination and Implementation Science for Health Promotion</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 464</td>
<td>Obesity and Cancer: Views from Molecules to Health Policy</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 475</td>
<td>Management of Disasters Due to Nature, War, or Terror</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 485</td>
<td>Adolescent Development</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 510</td>
<td>Health Disparities</td>
<td>3</td>
</tr>
<tr>
<td>ANTH 461</td>
<td>Urban Health</td>
<td>3</td>
</tr>
</tbody>
</table>

**Intensive Research Pathway**
The MPH is not a research degree, yet many use it as a springboard for a career in research. Some continue on for a PhD in a related field, such as Epidemiology. Others look for jobs as research assistants and compete for these jobs with people who have obtained a research master’s degree - often at a disadvantage due to their limited number (and level) of advanced research methods courses. The MPH degree offers a broad foundation in public health and experience in community settings and has great value both as a secondary degree (e.g. MD/MPH) and as a primary terminal degree. Yet even within the framework of an MPH degree, more can be done to accommodate those intending to pursue a career in research, either directly or by first pursuing a PhD. In addition to better preparing these students for research careers and PhD programs, students wishing to continue for a PhD (at CWRU or elsewhere) can, with by doing the IRP, get more credit towards their PhD degrees.

The goal is to create a unique hybrid that combined the benefits of a research level Master’s degree with the broader professional public health training of the MPH degree. This optional program of study can be completed with any of the MPH concentrations by completing the course list below (33 credits) plus any of the 9 credit concentration sequences.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPHP 406</td>
<td>History and Philosophy of Public Health</td>
<td>3</td>
</tr>
<tr>
<td>MPHP 411</td>
<td>Introduction to Health Behavior</td>
<td>3</td>
</tr>
</tbody>
</table>

MPHP 439  Public Health Management and Policy  3
MPHP 650  Public Health Practicum  3
MPHP 652  Public Health Capstone Experience  6
PQHS 414  Data Management and Statistical Programming  3
PQHS 431  Statistical Methods I  3
PQHS 432  Statistical Methods II  3
PQHS 465  Design and Measurement in Population Health Sciences  3
PQHS 490  Epidemiology: Introduction to Theory and Methods  3

**Concentration Course Sequence**  9

**Total Units**  42

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**PhD Epidemiology and Biostatistics**

**Questions and Information:**

Nickalaus Koziura, EdM

Master of Science - Biostatistics
Case Western Reserve University
10900 Euclid Avenue, W-G74
Cleveland, Ohio 44106-4945
216.368.3128 - phone
216.368.2286 - fax
nickalaus.koziura@case.edu (drabousky@case.edu)

The PhD Program in Epidemiology and Biostatistics draws on the core disciplines of biostatistics and epidemiology to support students in developing the knowledge, skills and competencies needed to assume positions of leadership with the ultimate goal of advancing population health. Students accepted into the PhD program will master the rigorous scientific and analytic methods necessary to be at the forefront of efforts to not only describe, but effectively evaluate and improve the public's health. The Department operates within a strong interdisciplinary framework involving faculty within the department, the school of medicine, and across the entire university, as well as leaders in health care and public health institutions and health oriented organizations and agencies locally, regionally, nationally, and internationally.

The educational mission of the Department of Epidemiology and Biostatistics PhD Program is to train students using an integrated approach that draws broadly from the population and quantitative health sciences. These include global, population, public, and community health, biostatistics, epidemiology, health behavior and prevention, genomic epidemiology, bioinformatics, and computational biology. This training provides the foundation for trainees to play integral roles in successfully solving our most pressing health problems.

To develop into the research leaders expected of our graduates, each student will take a common set of first and second year courses that provides extensive exposure to each of the areas noted above. By the end of their first year students will choose a mentor and laboratory in which to do their dissertation work. Research areas span all of the above and often combine these approaches with the expectation that cross-disciplinary studies will result in broader and more complete solutions to complex public health problems.

As part of their training all students will develop both a broad set of skills and competencies needed to perform cutting edge research as well as in-

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**Graduate Program in Health Promotion & Disease Prevention**

**Graduate Program in Health Promotion & Disease Prevention**

**Graduate Program in Health Promotion & Disease Prevention**

**Graduate Program in Health Promotion & Disease Prevention**

**Graduate Program in Health Promotion & Disease Prevention**

---
depth expertise in specific areas of particular relevance to their program of research. These will be developed through a combination of didactic coursework as well as individualized training within research teams led by their mentor.

A key component of our training program is to engage students in as many collaborative roles as practical. This will serve the important goal of giving each student a means to understand how to study the multiple determinants of health risk and outcomes, including biological and non-biological (environmental and social) influences, and the variation and disparity in outcomes.

Exposure to cutting edge research will be facilitated by our department-wide seminar that includes talks by world-leading experts both from off- and on-campus. As part of their training all students will participate in these seminars, including as speakers. This will help develop the necessary communication skills that is expected of successful researchers.

Graduates from accredited universities and colleges will be considered for admission to the department. All applicants must satisfy both CWRU and department requirements for graduate admission. Upon acceptance into the PhD program, each student will be assigned an academic advisor, who will guide the student through department and graduate school regulations, assist him or her in designing the initial planned program of study, and track the student's progress toward degree completion.

Research and training will be guided by a committee of faculty including the student's research advisor. The research advisor will have the major responsibility for facilitating, guiding, and advising the student in his or her research, but this will be done in consultation with the faculty committees. A Mentoring committee, selected after first year of Ph.D. training, will help students select courses and educational goals most useful for their research interests. This committee will be replaced at the end of the second year by a Dissertation committee that will play an important role in guiding the student's research project.

On completion of all Core Curriculum course requirements, students take a qualifying examination that is necessary to remaining and advancing in the program. Exceptions to required courses based on prior course work will be decided on a case by case basis.

Curriculum

The Doctor of Philosophy degree in Epidemiology and Biostatistics in the Department of Population and Quantitative Health Sciences comprises 42 credits from the following components:

- Core Curriculum (22 credits)
- Electives (20 credits)
- Department Research Seminar (6 semesters)
- Passing the Qualifying Exam
- Dissertation Research (18 credits)

Core Curriculum

The Core Curriculum is designed to provide PhD students with a strong foundation in epidemiology and biostatistics and related areas - the fields that comprise population and quantitative health sciences - and the methodological and analytic training to conduct a rigorous, high quality research in the student's selected specialization or concentration.

Core required courses include: Statistical Methods I & II, Introduction to Public Health, Introduction to Epidemiology, Design and Measurement in Population Health Sciences, Integrated Thinking in Population and Quantitative Health Sciences I & II, and Communicating in Population Health Science I & II.

Electives

Electives are chosen in consultation with the student's mentor and mentoring committee.

Seminars (0 credits)

Attending research seminars is integral to our graduate program and student's professional development. Students are required to attend weekly research seminars. These seminars provide a forum for students to develop skills in scientific presentation, thought and communication, and balance general and concentration-specific speakers and topics. Meeting locations may vary from week to week depending upon the speaker. Each student is required to attend in person six semesters of seminars. All students are required to present once a year during research seminars after their first year in the program.

Qualifying Exam

Following the completion of the core required courses at the end of their second year, students will take an oral exam based on required coursework that involves analyses of a novel data set. This will include a description of the results, their interpretation and a short proposal on alternative or future research directions based on these findings. Students will be given two attempts to pass this examination. A second failure will result in dismissal from the program.

Dissertation (18 credits)

After passing the qualifying examination and completing second year coursework, students will select a dissertation committee and develop a thesis proposal, based on anticipated research for their dissertation. This will be presented to the student’s Dissertation committee that will evaluate the written document and an oral defense of the document. This will be completed no later than the end of the fall semester of the third year. Successful completion of this exam will move the student to candidacy. Each student will be allowed two attempts to pass the oral defense of the proposal. Students are required to complete 18 credits of dissertation (EPBI 701) prior to graduation.

MPHP Courses

MPHP 101. Introduction to Public Health. 3 Units.

The purpose of this course is to introduce students to the science and art of public health through understanding historical and current issues through public health case histories and controversies. Students will be introduced to social, behavioral, cultural, and environmental influences on population health. Emphasis is placed on social justice as a central component of public health, with an overview of health inequity and commitment to vulnerable populations. Core public health practices relating to health promotion program design, community assessment and improvement planning, health communication, health policy and enforcement, and health behavior change will be featured. The course will promote understanding of health care and public health systems domestically and globally, including preparedness for and response to public health emergencies.
MPHP 301. Introduction to Epidemiology. 3 Units.
This course begins with the exploration of the history, philosophy and uses of epidemiology. It then moves to the basic descriptive functions of epidemiology such as condition, frequency and severity. Data is used to describe qualitatively and quantitatively diseases and injuries in a population. Applications include identifying patterns of disease and injury over time and geography. The course then moves to analytical epidemiology with focus on estimation, inference, bias, confounding and adjustment in the determination of what factors are associated with, or cause disease or injury. The different kinds of study designs are introduced including ecologic, cross-sectional, case-control, retrospective and prospective cohort, and experimental designs such as clinical trials. Students are introduced to evidence-based public health with analysis of harm, benefit and cost, and intervention effectiveness. The course concludes with applications to policy, covering outbreak investigation/testing/screening, public health policy and special epidemiologic applications including molecular and genetic epidemiology, environmental health and safety, unintentional injury and violence prevention and behavioral sciences. Recommended preparation: A course in statistics taken before or concurrently with MPHP 301.

MPHP 306. History and Philosophy of Public Health. 3 Units.
The purpose of this course is to introduce students to the science and art of public health through an understanding of the history and philosophies that represent its foundation. Students will learn about the essentials of public health and applications of those precepts throughout history and in the present. The course will examine public health case histories and controversies from the past and present, in order to better understand solutions for the future. Offered as MPHP 306 and MPHP 406. Prereq: Enrollment limited to juniors and seniors only.

MPHP 313. Health Education, Communication, and Advocacy. 3 Units.
Historical, sociological, and philosophical factors that have influenced definitions and the practice of health education and health promotion are studied. Advanced concepts in health communication theory will also be explored. This course is designed to educate, motivate, and empower undergraduate and graduate students to become advocates for their own health, the health of their peers, and the health of the community. Offered as MPHP 313 and MPHP 413.

MPHP 403. Research & Evaluation Methods. 3 Units.
This course is designed to provide an overview of research and evaluation methods for first-year MPH students. Through lecture, discussion and application exercises, students are introduced to the principles and processes of research and evaluation methods in public health, including formulation of research questions, aims and hypotheses and evaluation goals and objectives; literature review; development/selection of conceptual and theoretical models; quantitative, qualitative and evaluation project management; and application of ethical principles and protection of human subjects in public health research and evaluation.

MPHP 405. Statistical Methods in Public Health. 3 Units.
This one-semester survey course for public health students is intended to provide the fundamental concepts and methods of biostatistics as applied predominantly to public health problems. The emphasis is on interpretation and concepts rather than calculations. Topics include descriptive statistics; vital statistics; sampling; estimation and significance testing; sample size and power; correlation and regression; spatial and temporal trends; small area analysis; statistical issues in policy development. Examples of statistical methods will be drawn from public health practice. Use of computer statistical packages will be introduced. Prereq: Enrollment limited to MPH students (Plan A or Plan B) and EPBI students only. All others require instructor consent.

MPHP 406. History and Philosophy of Public Health. 3 Units.
The purpose of this course is to introduce students to the science and art of public health through an understanding of the history and philosophies that represent its foundation. Students will learn about the essentials of public health and applications of those precepts throughout history and in the present. The course will examine public health case histories and controversies from the past and present, in order to better understand solutions for the future. Offered as MPHP 306 and MPHP 406. Prereq: Enrollment limited to MPH students (Plan A or Plan B) and EPBI students or instructor consent.

MPHP 411. Introduction to Health Behavior. 3 Units.
Using a biopsychosocial perspective, an overview of the measurement and modeling of behavioral, social, psychological, and environmental factors related to disease prevention, disease management, and health promotion is provided. Offered as PQHS 411 and MPHP 411. Prereq: Enrollment limited to MPH students (Plan A or Plan B) and EPBI students or consent.

MPHP 413. Health Education, Communication, and Advocacy. 3 Units.
Historical, sociological, and philosophical factors that have influenced definitions and the practice of health education and health promotion are studied. Advanced concepts in health communication theory will also be explored. This course is designed to educate, motivate, and empower undergraduate and graduate students to become advocates for their own health, the health of their peers, and the health of the community. Offered as MPHP 313 and MPHP 413.

MPHP 421. Health Economics and Strategy. 3 Units.
The purpose of this course is to develop the analytical skills necessary for understanding how the U.S. health care sector operates, how it has evolved, the forces at work behind perceived deficiencies (in quality and cost control), and the impact of alternative policy proposals. Special attention is given to recent developments in the healthcare marketplace, and the strategic considerations they create for providers and insurers. These issues are addressed through the lens of microeconomic theory. Under this framework, outcomes result from the interaction of decisions made by participants in the healthcare economy (e.g. patients, providers, insurers, government), with those decisions governed by the preferences, incentives and resource constraints facing each decision-maker. Principles of microeconomics will be reviewed as necessary to ensure consistent understanding of basic concepts. The course is designed to appeal to a broad audience, particularly students interested in healthcare management, public health, medical innovation, health law, and public policymaking. Offered as HSMC 421 and MPHP 421.

MPHP 429. Introduction to Environmental Health. 3 Units.
This survey course will introduce students to environmental and occupational health topics including individual, community, population, and global issues. Students will develop an understanding of the human health impacts of physical, biological, and chemical agents in the environment and workplace including basic principles of toxicology. Presentation of concepts including risk assessment, communication and management as well as discussion of environmental and occupational practices, policies and regulations that promote public and population health is included.

MPHP 431. Statistical Methods I. 3 Units.
Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs. First part of year-long sequence. Offered as ANAT 431, BIOL 431, CRSP 431, PQHS 431 and MPHP 431.
MPHP 432. Statistical Methods II. 3 Units.
Methods of analysis of variance, regression and analysis of quantitative data. Emphasis on computer solution of problems drawn from the biomedical sciences. Design of experiments, power of tests, and adequacy of models. Offered as BIOL 432, PQHS 432, CRSP 432 and MPHP 432. Prereq: PQHS/EPBI 431 or equivalent.

MPHP 433. Community Interventions and Program Evaluation. 3 Units.
This course prepares students to design, conduct, and assess community-based health interventions and program evaluation. Topics include assessment of need, evaluator/stakeholder relationship, process vs. outcome-based objectives, data collection, assessment of program objective achievement based on process and impact, cost-benefit analyses, and preparing the evaluation report to stakeholders. Recommended preparation: PQHS/EPBI 490, PQHS/EPBI 431, or MPHP 405. Offered as PQHS 433 and MPHP 433. Prereq: MPHP 411

MPHP 439. Public Health Management and Policy. 3 Units.
This course is designed to introduce students to the basics of health policy-making and includes a background on the basic structure and components of the US Health Care System (such as organization, delivery and financing). It will also cover introductory concepts in public health management, including the role of the manager, organizational design and control, and accountability. We will address relevant legal, political and ethical issues using case examples. At the end of the course, students will understand how health policy is developed and implemented in various contexts, and the challenges facing system-wide efforts at reform. This is a required course for the MPH degree. Grades will be based on a series of assignments. Prereq: Enrollment limited to MPH students (Plan A or Plan B) and EPBI Students or instructor consent.

MPHP 447. Global Health: Outreach Investigation in Real-Time. 3 Units.
This course provides a trans-cultural, trans-disciplinary, multimedia learning experience by analyzing historical and real-time data from the annual dengue endemics and sporadic epidemics in Puerto Rico and Brazil. A rigorous problem-centered training in the epidemiology, prevention, treatment, and control of infectious diseases using real-time and historical surveillance data of endemic and epidemic Dengue in Bahia, Brazil. This is an advanced epidemiology course in which core material will be primarily taught through reading assignments, class discussion, group projects, and class presentations. The course will utilize the online web-based communication and learning technology to create a single classroom between the CWRU and international partners with unique and complementary skills. In addition to joint classroom lectures across sites, student groups will also perform smaller-scale videoconference meetings for assigned group projects, thus creating strong international connections for the students, faculty, and our institutions. Note: Due to the complexities of time zones for this international course, the course will begin at 8:00a.m. until the U.S.A. adjusts clocks for Daylight Savings Time (unlike Brazil). Therefore, classes after the second week of March will begin at 9:00a.m. Offered as PQHS 447, INTH 447 and MPHP 447.

MPHP 450. Clinical Trials and Intervention Studies. 3 Units.
Issues in the design, organization, and operation of randomized, controlled clinical trials and intervention studies. Emphasis on long-term multicenter trials. Topics include legal and ethical issues in the design; application of concepts of controls, masking, and randomization; steps required for quality data collection; monitoring for evidence of adverse or beneficial treatment effects; elements of organizational structure; sample size calculations and data analysis procedures; and common mistakes. Recommended preparation: PQHS/EPBI 431 or consent of instructor. Offered as PQHS 450 and MPHP 450.

MPHP 451. A Data-Driven Introduction to Genomics and Human Health. 3 Units.
This course introduces the foundational concepts of genomics and genetic epidemiology through four key principles: 1) Teaching students how to query relational databases using Structure Query Language (SQL); 2) Exposing students to the most current data used in genomics and bioinformatics research, providing a quantitative understanding of biological concepts; 3) Integrating newly learned concepts with prior ones to discover new relationships among biological concepts; and 4) providing historical context to how and why data were generated and stored in the way they were, and how this gave rise to modern concepts in genomics. Offered as PQHS 451, GENE 451, and MPHP 451.

MPHP 456. Health Policy and Management Decisions. 3 Units.
This seminar course combines broad health care policy issue analysis with study of the implications for specific management decisions in organizations. This course is intended as an applied, practical course where the policy context is made relevant to the individual manager. Offered as HSMC 456 and MPHP 456.

MPHP 460. Introduction to Health Services Research. 3 Units.
This survey course provides an introduction to the field of Health Services Research and an overview of key health services research concepts and methods, including conceptual frameworks and models; outcomes research; risk adjustment; disparities in health care; policy/health care systems; cost and cost-effectiveness; quality of life, process improvement; patient satisfaction; patient safety; health economics; statistical modeling techniques; and qualitative research methods. Offered as PQHS 460 and MPHP 460.

MPHP 464. Obesity and Cancer: Views from Molecules to Health Policy. 3 Units.
This course will provide an overview of the components of energy balance (diet, physical activity, resting metabolic rate, dietary induced thermogenesis) and obesity, a consequence of long term positive energy balance, and various types of cancer. Following an overview of energy balance and epidemiological evidence for the obesity epidemic, the course will proceed with an introduction to the cellular and molecular biology of energy metabolism. Then, emerging research on biologically plausible connections and epidemiological associations between obesity and various types of cancer (e.g., colon, breast) will be presented. Finally, interventions targeted at decreasing obesity and improving quality of life in cancer patients will be discussed. The course will be cooperatively-taught by a transdisciplinary team of scientists engaged in research in energy balance and/or cancer. Didactic lectures will be combined with classroom discussion of readings. The paper assignment will involve application of course principles, lectures and readings. Offered as PQHS 464 and MPHP 464.

MPHP 466. Promoting Health Across Boundaries. 3 Units.
This course examines the concepts of health and boundary spanning and how the synergy of the two can produce new, effective approaches to promoting health. Students will explore and analyze examples of individuals and organizations boundary spanning for health to identify practice features affecting health, compare and contrast practices and approaches, and evaluate features and context that promote or inhibit boundary spanning and promoting health. Offered as MPHP 466, PQHS 466, SOCI 466, NURS 466 and BETH 466. Prereq: Graduate student status or instructor consent.
MPHP 467. Comparative and Cost Effectiveness Research. 1 Unit.
Comparative effectiveness research is a cornerstone of healthcare reform. It holds the promise of improved health outcomes and cost containment. This course is presented in a convenient 5-day intensive format in June. There are reading assignments due prior to the 1st session. Module A, Days 1-2: Overview of comparative effectiveness research (CER) from a wide array of perspectives: individual provider, institution, insurer, patient, government, and society. Legal, ethical and social issues, as well as implications for population and public health, including health disparities will also be a component. Module B, Day 3: Introduction to the various methods, and their strengths, weaknesses and limitations. How to read and understand CER papers. Module C, Days 4-5: Cost-Effectiveness Analysis. This will cover costing, cost analysis, clinical decision analysis, quality of life and cost-effectiveness analysis for comparing alternative health care strategies. Trial version of TreeAge software will be used to create and analyze a simple cost-effectiveness model. The full 3-credit course is for taking all 3 modules. Modules A or C can be taken alone for 1 credit. Modules A and B or Modules B and C can be taken together for a total of 2 credits. Module B cannot be taken alone. If taking for 2 or 3 credits, some combination of term paper, project and/or exam will be due 30 days later. Offered as PQHS 467 and MPHP 467.

MPHP 468. The Continual Improvement of Healthcare: An Interdisciplinary Course. 3 Units.
This course prepares students to be members of interprofessional teams to engage in the continual improvement in health care. The focus is on working together for the benefit of patients and communities to enhance quality and safety. Offered as PQHS 468, MPHP 468, and NURS 468.

MPHP 475. Management of Disasters Due to Nature, War, or Terror. 3 Units.
The purpose of this course is to make participants aware of the special needs of children and families in disaster situations and understand public health approaches to address these needs. The learning objectives for this course are: 1) Identify the most important problems and priorities for children in disaster situations, 2) Identify the organizations most frequently involved in providing assistance in disaster situations and define their roles and strengths, 3) Describe the reasons why children are among the most vulnerable in disaster events, 4) Conduct emergency nutritional assessments for children, 5) Develop health profiles on displaced children and plan interventions based on results, 6) Define common psychosocial issues of children and the means to address them, 7) List basic points of international law including the Geneva Convention that relate to all persons involved in disaster situations, 8) List important security issues, 9) Appreciate ethical issues involved in disaster situations and employ skills of cross cultural communication, 10) Recognize and respond to special issues for children involved in biological and chemical terrorist attacks.

MPHP 477. Internship at Health-Related Government Agencies. 3 Units.
This independent study course will incorporate a one-semester-long internship at health-related government agencies (Ohio Department of Health, Ohio Department of Job and Family Services, or Cleveland City Health Department). The choice of the agency will depend on the student's academic interests and research goals. The objective is to develop a level of familiarity with the organizational and operational aspects of such agencies, and to gain an understanding of agencies' and bureaus' interactions with the legislative body, as well as the processes of developing, implementing, managing, and monitoring health initiative. The instructor and the liaison persons at the agencies will be responsible for planning structured encounters of interns with key administrators and policy makers, and to select a research project, based on the intern's research interests and the agencies' research priorities. Interns will be required to submit a draft of the report to the instructor at the end of the semester. The approved, final report will be submitted to the agency. The project will be evaluated for its methodological soundness and rigor. Students will be required to be at the agency one day a week. Recommended preparation: PQHS/EPBI 515.

MPHP 482. Qualitative and Mixed Methods in Public Health. 3 Units.
Understanding complex public health issues requires both qualitative and quantitative inquiry. The exploration of the perceptions and experiences of people is as essential as analyzing the relationships among variables. Often, the integration of the two methods is required in order to effectively address the significant health issues faced by today's society. It is the purpose of this course to facilitate a meaningful and substantive learning process around engaging in, and critically analyzing, qualitative and mixed methods research in public health. This includes gaining first-hand experience in research design and collecting, managing, analyzing, and interpreting data for the purposes of making data-driven program and policy recommendations. In addition, students will have the opportunity to engage with local professionals engaged in qualitative and mixed methods research.

MPHP 483. Introduction to Epidemiology for Public Health Practice. 3 Units.
This course is designed to introduce the basic principles and methods of epidemiology. Epidemiology has been referred to as the basic science for public health. Application of epidemiologic principles is critical to disease prevention, as well as in the development and evaluation of public policy. The course will emphasize basic methods (study design, measures of disease occurrence, measures of association, and causality) necessary for epidemiologic research. It is intended for students who have a basic understanding of the principals of human disease as well as statistics. Prereq: Must be an MPHP Plan A or MPHP Plan B, or EPBI student in order to enroll in the course.
**MPHP 484. Global Health Epidemiology. 1 - 3 Units.**
This course provides a rigorous problem-centered training in the epidemiology, prevention, treatment, and control of infectious diseases and, more generally, global health. This is an advanced epidemiology that embraces an active learning environment. Students are expected to invest time out of the classroom reading and working with classmates. Classes will be conducted with discussions, debates, group projects, and group presentations. By taking this course, students will develop a framework for interpreting, assessing, and performing epidemiologic research on issues of global importance. The course will be divided into three modules: 1) Global Health Epidemiology 2) Helminth Epidemiology, and 3) Epidemiology of Disease Elimination. Each module is worth 1 credit hour and may be taken separately. Each module will have a separate project and/or exam. The final exam time will be used for group presentations and panel discussion. Active class participation is required through discussions, case studies, and group projects. Offered as PQHS 484, INTH 484, and MPHP 484.

**MPHP 485. Adolescent Development. 3 Units.**
Adolescent Development can be viewed as the overriding framework for approaching disease prevention and health promotion for this age group. This course will review the developmental tasks of adolescence and identify the impact of adolescent development on youth risk behaviors. It will build a conceptual and theoretical framework through which to address and change adolescent behavior to promote health.

**MPHP 490. Epidemiology: Introduction to Theory and Methods. 3 Units.**
This course provides an introduction to the principles of epidemiology covering the basic methods necessary for population and clinic-based research. Students will be introduced to epidemiologic study designs, measures of disease occurrence, measures of risk estimation, and casual inference (bias, confounding, and interaction) with application of these principles to specific fields of epidemiology. Classes will be a combination of lectures, discussion, and in-class exercises. It is intended for students who have a basic understanding of the principals of human disease and statistics. Offered as PQHS 490 and MPHP 490. Prereq or Coreq: PQHS/EPBI 431 or Requisites Not Met permission.

**MPHP 494. Infectious Disease Epidemiology. 3 Units.**
This course focuses on tuberculosis (TB) and HIV epidemiology, including perspectives on these diseases in the US and globally. It is a follow-up to PQHS/MPHP 484: Global Health Epidemiology, but these courses do not necessarily need to be taken in sequence. This is an advanced course, focusing on methods and approaches in epidemiology and public health. Offered as PQHS 494, INTH 494 and MPHP 494. Prereq: PQHS/EPBI 490.

**MPHP 499. Independent Study. 1 - 18 Units.**

**MPHP 510. Health Disparities. 3 Units.**
This course aims to provide theoretical and application tools for students from many disciplinary backgrounds to conduct research and develop interventions to reduce health disparities. The course will be situated contextually within the historical record of the United States, reviewing social, political, economic, cultural, legal, and ethical theories related to disparities in general, with a central focus on health disparities. Several frameworks regarding health disparities will be used for investigating and discussing the empirical evidence on disparities among other subgroups (e.g., the poor, women, uninsured, disabled, and non-English speaking populations) will also be included and discussed. Students will be expected to develop a research proposal (observational, clinical, and/or intervention) rooted in their disciplinary background that will incorporate materials from the various perspectives presented throughout the course, with the objective of developing and reinforcing a more comprehensive approach to current practices within their fields. Offered as CRSP 510, PQHS 510, MPHP 510, NURS 510, and SASS 510.

**MPHP 532. Health Care Information Systems. 3 Units.**
This course covers concepts, techniques and technologies for providing information systems to enhance the effectiveness and efficiency of health care organizations. Offered as HSMC 432 and MPHP 532.

**MPHP 540. Operational Aspects of Global Health and Emergency Response. 3 Units.**
Among professional in the medical field and the field of public health, there is a gap in knowledge, structure and research in best practices surrounding emergency response. This gap results from the limited number of training programs in the United States that focus on this very specialized field and the limited number of academic partnerships with international non-governmental organizations (NGOs). This course helps remedy this gap by introducing public health students and international emergency medicine fellows to the overall structure and operations of international humanitarian coordination systems, types of emergency response, morbidity and mortality associated with various emergencies, and the actors and institutions involved. The course highlights, through reading, workshops, and examples, the real world issues that must be faced and overcome in the field during emergency response operations.

**MPHP 650. Public Health Practicum. 1 - 3 Units.**
The Public Health Practicum is an integral component of the MPH curriculum, allowing students to apply, develop, and refine their conceptual knowledge and skills as part of a planned, supervised, and evaluated community-based experience. The Practicum is designed to move students beyond the walls of academia, to understand the political, economic, social, and organizational contexts within which public health activities are conducted. To complete the Practicum, students must complete three credits of MPHP 650, dedicating at least 120 hours to a substantial public health experience, and attend Community Health Research and Practice (CHRP) group meetings. Prereq: Complete at least 9 credit hours in the MPH program and be in good academic standing.

**MPHP 652. Public Health Capstone Experience. 1 - 9 Units.**
Public health field practicum, involving a placement at a community-based field site, and a Master's essay. The field placement will provide students with the opportunity to apply the knowledge and skills acquired through their Master of Public Health academic program to a problem involving the health of the community. Students will learn to communicate with target groups in an effective manner, to identify ethical, social, and cultural issues related to public health policies, research, and interventions; to identify the process by which decisions are made within the agency or organization; and to identify and coordinate use of resources at the placement site. The Master's essay represents the culminating experience required for the degree program and may take the form of a research thesis, an evaluation study, or an intervention study. Each student is required to formally present the experience and research findings. In any semester in which a student is registered for MPHP 652 credit, it is required that the student attend the Community Health Research and Practice (CHRP) group at a minimum of two sessions per 3 credits. CHRP is held once a week for approximately an hour and a half for the duration of fall, spring, and summer semesters. MPHP 652 credit is available only to Master of Public Health students.
MPHP 655. Dual Degree Field Practicum II. 3 Units.
This course is designed to be taken by MSSA/MPH joint degree students as the second field period of their master's program. It consists of a field practicum and participation in professional development opportunities. The Field Practicum is an integral component of the MSASS and MPH curriculums, allowing students to apply, develop, and refine their conceptual knowledge and skills as part of a planned, supervised, and evaluated community-based experience. The Practicum is designed to move students beyond the walls of academia, to understand the political, economic, social, and organizational contexts within which social work and public health activities are conducted. These collective experiences provide students with a forum to develop skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent developing practitioners. (EPAAS Program Objective M6 and EPAAS Content Area 4.7) The overall goal of this course is to provide graduate level MSSA/MPH joint degree students with field related opportunities to continue to develop foundation level competencies in the eight MSSAS abilities by helping students apply knowledge of social work and public health theory, skills, values and ethics acquired in the classroom in an agency setting. Offered as MPHP 655 and SASS 655.

MPHP 656. Dual Degree Field Capstone III. 3 Units.
The Public Health Capstone Project is an integral component of the MPH curriculum, allowing students to apply, develop, and refine their conceptual knowledge and skills as part of a planned, mentored, and evaluated public health scholarly project. This course is designed to be taken by advanced level students. It consists of a 288 hour field based Capstone experience and participation in 12 hours of professional development opportunities. The overall goal of this course is designed to move students beyond the walls and constraints of the classroom, to understand the political, economic, social, and organizational contexts within which public health and social work activities are conducted. It is also designed to provide graduate level dual degree students with field related opportunities to begin to develop advanced level competencies in the eight abilities by helping students apply knowledge of social work theory, skills, values and ethics acquired in the classroom in an agency setting. These collective experiences provide students with a forum to continue to develop and hone social work skills, integrate and operationalize the values and ethics inherent in professional practice, and confront social injustice as self-reflective, competent developing practitioners. (EPAAS Program Objective M6 and EPAAS Content Area 4.7) The overall goal of this course is to provide graduate level MSSA/MPH joint degree students with field related opportunities to continue to develop foundation level competencies in the eight MSSAS abilities by helping students apply knowledge of social work and public health theory, skills, values and ethics acquired in the classroom in an agency setting. Offered as MPHP 655 and SASS 655.

PQHS Courses

PQHS 411. Introduction to Health Behavior. 3 Units.
Using a biopsychosocial perspective, an overview of the measurement and modeling of behavioral, social, psychological, and environmental factors related to disease prevention, disease management, and health promotion is provided. Offered as PQHS 411 and MPHP 411. Prereq: Enrollment limited to MPH students (Plan A or Plan B) and EPBI students or consent.

PQHS 414. Data Management and Statistical Programming. 3 Units.
This is an online course that offers no in-person meetings. This course serves as a general introduction to the use of computer systems in epidemiologic investigations and biostatistical applications. Students will develop a conceptual understanding of data types, basic data structures, relational database systems and data normalization, data warehousing, control statements, and programming logic. Further, students will develop basic scripting skills and will learn to read in, manipulate, and perform basic descriptive analyses on research data using the SAS programming language. Primary emphasis in this course is on developing the knowledge and familiarity required to work with data in a statistical programming context. Basic familiarity with statistics is beneficial, as this course does not teach inferential statistical analysis in detail, but it is not vital to learning the course material.

PQHS 415. Statistical Computing and Data Analytics. 3 Units.
Statistical computing is an essential part of modern statistical training. This course emphasizes on statistical and data analytic problem solving skills, covers elements of statistical computing, and special topics in modern data analytics. This includes numerical methods for statistics, stochastic simulation, symbolic and graphical computation, plus special topics in resampling methods, EM algorithms, Gibbs Sampling/MCMC, projection pursuit, Laplace approximation, parallel computing, and selected methods for big and high dimensional data. The course will use R/Splus predominantly. However, interface of R with another high level programming language such as C, C++, Fortran, JAVA or Python will be essential for Big Data and intensive computation. Some Matlab, Mathematica, and graphviz will be used for symbolic and graphical computation. Prerequisite: Knowledge in statistics, equivalent to that in either STAT 325/425, or STAT 345/445, or PQHS/EPBI 481, or PQHS/EPBI 431, or by permission. Experience with at least one programming language is required: R/Splus, Matlab, C/C++, Fortran, JAVA, or Python. Prereq: STAT 312, STAT 325, STAT 425, STAT 345, STAT 445, PQHS/EPBI 431 or PQHS/EPBI 481.

PQHS 423. Dissemination and Implementation Science for Health Promotion. 3 Units.
This graduate-level course introduces concepts, skills, and methods for systematically disseminating and implementing evidence-based interventions for population health promotion. The course includes a focus on developing partnerships and transdisciplinary research teams, applying theories and frameworks to guide dissemination and implementation (D & I) science, examining research methods and designs appropriate for conducting D & I research at different and multiple levels of intervention (e.g., clinical, community, policy), and exploring channels for effectively communicating evidence to inform decision-making and practice in diverse contexts. Recommended preparation: PQHS/EPBI 411 or grad. level behavioral theory equivalent; PQHS/EPBI 490 or MPHP 483 or graduate level research methods equivalent.
PQHS 431. Statistical Methods I. 3 Units.
Application of statistical techniques with particular emphasis on problems in the biomedical sciences. Basic probability theory, random variables, and distribution functions. Point and interval estimation, regression, and correlation. Problems whose solution involves using packaged statistical programs. First part of year-long sequence. Offered as ANAT 431, BIOL 431, CRSP 431, PQHS 431 and MPH 431.

PQHS 432. Statistical Methods II. 3 Units.
Methods of analysis of variance, regression and analysis of quantitative data. Emphasis on computer solution of problems drawn from the biomedical sciences. Design of experiments, power of tests, and adequacy of models. Offered as BIOL 432, PQHS 432, CRSP 432 and MPH 432. Prereg: PQHS/EPBI 431 or equivalent.

PQHS 433. Community Interventions and Program Evaluation. 3 Units.
This course prepares students to design, conduct, and assess community-based health interventions and program evaluation. Topics include assessment of need, evaluator/stakeholder relationship, process vs. outcome-based objectives, data collection, assessment of program objective achievement based on process and impact, cost-benefit analyses, and preparing the evaluation report to stakeholders. Recommended preparation: PQHS/EPBI 490, PQHS/EPBI 431, or MPH 405. Offered as PQHS 433 and MPH 433.

PQHS 435. Survival Data Analysis. 3 Units.
Basic concepts of survival analysis including hazard function, survival function, types of censoring; non-parametric models; extended Cox models: time dependent variables, piece-wise Cox model, etc.; sample size requirements for survival studies. Prereq: PQHS/EPBI 432.

PQHS 436. Essence of Multilevel Statistical Modeling, Including Repeated Measures Analysis. 1 Unit.
A brief introduction to statistical models to handle studies having observational units (cases) at multiple levels (hierarchies). In particular, cases are often nested within groups, such as distinct communities, healthcare centers, or schools. Because the cases are not independent, conventional statistical methods assuming single-level data such as ordinary least squares regression are not appropriate. Multilevel designs allow examination of the effects of both individual (micro-level) factors as well as of higher level (macro or contextual) factors, and their interactions, on outcomes of interest. Longitudinal and other repeated measures analyses are a special case of multilevel modeling where the repeated measurements are nested within subjects or cases. Methods covered include use of linear mixed models, including random coefficient regression models, for continuous normally distributed outcomes, and generalized linear mixed modeling techniques for binary and count outcomes. Marginal regression modeling using generalized estimating equations (GEE) techniques, is introduced and contrasted to the use of mixed models. Examples and use of software (primarily SAS) are stressed in order to develop a strong conceptual understanding of the models. Prereq: PQHS/EPBI 432 or Requisites Not Met permission.

PQHS 437. Essence of Classical Multivariate Analysis. 1 Unit.
A brief introduction to classical multivariate analysis methods: data visualization, two-group discriminant analysis via Hotelling's test, principal components and exploratory factor analysis, cluster analysis. Examples and wise use of software R are stressed in order to develop a strong conceptual understanding of the methods. This course joins PQHS 436 and 438 as the three-step "essence" series in advanced statistical methods required for the PhD in Population Health Science. Prereq: PQHS/EPBI 432 or Requisites Not Met permission.

PQHS 438. Essence of Structural Equation Modeling. 1 Unit.
Brief introduction to classic "linear structural relations" (LISREL) formulation of structural equation models: Building them to address specific research aims. Fitting and assessing the goodness of the fit. Prudent interpretations. Examples and wise use of software are stressed in order to develop a strong conceptual understanding. This course joins PQHS 436 and 437 as the three-step "essence" series in advanced statistical methods required for the PhD in Population Health Science. Prereq: PQHS/EPBI 432 or Requisites Not Met permission.

PQHS 440. Introduction to Population Health. 3 Units.
Introduces graduate students to the multiple determinants of health including the social, economic and physical environment, health services, individual behavior, genetics and their interactions. It aims to provide students with the broad understanding of the research development and design for studying population health, the prevention and intervention strategies for improving population health and the disparities that exist in morbidity, mortality, functional and quality of life. Format is primarily group discussion around current readings in the field; significant reading is required.

PQHS 444. Communicating in Population Health Science Research. 2 Units.
Doctoral seminar on writing journal articles to report original research, and preparing and making oral and poster presentations. The end products are ready-to-submit manuscripts and related slide and poster presentations for the required first-year research project in the PhD program in the Department of Epidemiology and Biostatistics. While this course provides a nucleus for this endeavor, students work intensively under the supervision of their research mentors, who guide all stages of the work including providing rigorous editorial support. Seminar sessions are devoted to rigorous peer critiques of every stage of the projects and to in-depth discussions of assigned readings. Recommended preparation: PhD students in the Department of Biostatistics and Epidemiology. Non-PhD EPBI students permitted if space available. Fluency in English writing (e.g., in accord with the Harbrace College Handbook). Prereq: PQHS/EPBI 431 and PQHS/EPBI 490. Coreq: PQHS/EPBI 432.

PQHS 445. Research Ethics in Population Health Sciences. 0 Unit.
This zero credit course is a required add-on for PhD students in EPBI. Students will register and fulfill all requirements for IBMS 500 "Being a Professional Scientist". The purpose of PQHS 445 is to address specialized population health topics not covered by IBMS 500, including international research, human genomics, and/or big data/electronic medical records. There will be no meetings/lectures for this course. Students will complete a short written assignment due at the end of the semester.
PQHS 447. Global Health: Outbreak Investigation in Real-Time. 3 Units.
This course provides a trans-cultural, trans-disciplinary, multimedia learning experience by analyzing historical and real-time data from the annual dengue endemics and sporadic epidemics in Puerto Rico and Brazil. A rigorous problem-centered training in the epidemiology, prevention, treatment, and control of infectious diseases using real-time and historical surveillance data of endemic and epidemic Dengue in Bahia, Brazil. This is an advanced epidemiology course in which core material will be primarily taught through reading assignments, class discussion, group projects, and class presentations. The course will utilize the online web-based communication and learning technology to create a single classroom between the CWRU and international partners with unique and complementary skills. In addition to joint classroom lectures across sites, student groups will also perform smaller-scale videoconference meetings for assigned group projects, thus creating strong international connections for the students, faculty, and our institutions. Note: Due to the complexities of time zones for this international course, the course will begin at 8:00a.m. until the U.S.A. adjusts clocks for Daylight Savings Time (unlike Brazil). Therefore, classes after the second week of March will begin at 9:00a.m. Offered as PQHS 447, INTH 447 and MPH 447. Prereq: PQHS/EPBI 490.

PQHS 450. Clinical Trials and Intervention Studies. 3 Units.
Issues in the design, organization, and operation of randomized, controlled clinical trials and intervention studies. Emphasis on long-term multicenter trials. Topics include legal and ethical issues in the design; application of concepts of controls, masking, and randomization; steps required for quality data collection; monitoring for evidence of adverse or beneficial treatment effects; elements of organizational structure; sample size calculations and data analysis procedures; and common mistakes. Recommended preparation: PQHS/EPBI 431 or consent of instructor. Offered as PQHS 450 and MPHP 450.

PQHS 451. A Data-Driven Introduction to Genomics and Human Health. 3 Units.
This course introduces the foundational concepts of genomics and genetic epidemiology through four key principles: 1) Teaching students how to query relational databases using Structure Query Language (SQL); 2) Exposing students to the most current data used in genomics and bioinformatics research, providing a quantitative understanding of biological concepts; 3) Integrating newly learned concepts with prior ones to discover new relationships among biological concepts; and 4) Providing historical context to how and why data were generated and stored in the way they were, and how this gave rise to modern concepts in genomics. Offered as PQHS 451, GENE 451, and MPH 451. Prereq: PQHS/EPBI 431 and PQHS/EPBI 490 or Requisites Not Met permission.

PQHS 452. Statistical Methods for Genetic Epidemiology. 3 Units.
Analytic methods for evaluating the role of genetic factors in human disease, and their interactions with environmental factors. Statistical methods for the estimation of genetic parameters and testing of genetic hypotheses, emphasizing maximum likelihood methods. Models to be considered will include such components as genetic loci of major effect, polygenic inheritance, and environmental, cultural and developmental effects. Topics will include familial aggregation, segregation and linkage analysis, ascertainment, linkage disequilibrium, and disease marker association studies. Recommended preparation: PQHS/EPBI 431 and PQHS/EPBI 451.

PQHS 453. Categorical Data Analysis. 3 Units.
Categorical data are often encountered in many disciplines including in the fields of clinical and biological sciences. Analysis methods for analyzing categorical data are different from the analysis methods for continuous data. There is a rich a collection of methods for categorical data analysis. The elegant “odds ratio” interpretation associated with categorical data is a unique one. This online course will cover cross-sectional categorical data analysis theories and methods. From this course students will learn standard categorical data analysis methods and its applications to the biomedical and clinical studies. This particular course will focus mostly on statistical methods for categorical data analysis arising from various fields of studies including clinical studies; those who take it will come from a wide variety of disciplines. The course will include video lectures, group discussion and brainstorming, homework, simulations, and collaborative projects on real and realistic problems in human health tied directly to the student’s own professional interests. Focus will be given to logistic regression methods. Topics include (but not limited to) binary response, multi-category response, count response, model selection and evaluation, exact inference, Bayesian methods for categorical data, and supervised statistical learning methods. This course stresses how the core statistical principles, computing tools, and visualization strategies are used to address complex scientific aims powerfully and efficiently, and to communicate those findings effectively to researchers who may have little or no experience in these methods. Recommended preparation: Advanced undergraduate students, and graduate students in Biostatistics or other quantitative sciences with a background in statistical methods (at least one statistics course, equivalent to the PQHS/EPBI 431 course experience).

PQHS 454. Population Genetics for Genetic Epidemiology. 3 Units.
Introduce concepts and classical results of mathematical population genetics, with emphasis on the influence of evolutionary forces and population history on contemporary human genetic variation. Survey empirical population variation and their implication for mapping complex traits. How to simulate population sequence data using coalescence models will also be emphasized.

PQHS 457. Current Issues in Genetic Epidemiology: Design and Analysis of Sequencing Studies. 3 Units.
Statistical methods to deal with the opportunities and challenges in Genetic Epidemiology brought about by modern sequencing technology. Some computational issues that arise in the analysis of large sequence data sets will be discussed. The course includes hands-on experience in the analysis of large sequence data sets, in a collaborative setting. Prereq: PQHS/EPBI 451 and PQHS/EPBI 452.

PQHS 459. Longitudinal Data Analysis. 3 Units.
This course will cover statistical methods for the analysis of longitudinal data with an emphasis on application in biological and health research. Topics include exploratory data analysis, response feature analysis, growth curve models, mixed-effects models, generalized estimating equations, and missing data. Prereq: PQHS/EPBI 432.

PQHS 460. Introduction to Health Services Research. 3 Units.
This survey course provides an introduction to the field of Health Services Research and an overview of key health services research concepts and methods, including conceptual frameworks and models; outcomes research; risk adjustment; disparities in health care; policy/health care systems; cost and cost-effectiveness; quality of life, process improvement; patient satisfaction; patient safety; health economics; statistical modeling techniques; and qualitative research methods. Offered as PQHS 460 and MPHP 460.
PQHS 464. Obesity and Cancer: Views from Molecules to Health Policy. 3 Units.
This course will provide an overview of the components of energy balance (diet, physical activity, resting metabolic rate, dietary induced thermogenesis) and obesity, a consequence of long term positive energy balance, and various types of cancer. Following an overview of energy balance and epidemiological evidence for the obesity epidemic, the course will proceed with an introduction to the cellular and molecular biology of energy metabolism. Then, emerging research on biologically plausible connections and epidemiological associations between obesity and various types of cancer (e.g., colon, breast) will be presented. Finally, interventions targeted at decreasing obesity and improving quality of life in cancer patients will be discussed. The course will be cooperatively-taught by a transdisciplinary team of scientists engaged in research in energy balance and/or cancer. Didactic lectures will be combined with classroom discussion of readings. The paper assignment will involve application of course principles, lectures and readings. Offered as PQHS 464 and MPHP 464.

PQHS 465. Design and Measurement in Population Health Sciences. 3 Units.
This course focuses on common design and measurement approaches used in population health sciences research. This course covers the preliminary considerations used in selecting qualitative, quantitative and mixed methods research approaches including an understanding of different philosophical worldviews, strategies of inquiry and methods and procedures for each approach. The course also includes an introduction to survey design and related concepts of latent variables, factor analysis and reliability and validity. Students will develop an in-depth knowledge of these design and measurement approaches through readings, lectures, group discussions and written and oral project presentations. Prereq: PQHS/EPBI 440, PQHS/EPBI 431, PQHS/EPBI 490, PQHS/EPBI 432, PQHS/EPBI 460, PQHS/EPBI 444 and PQHS/EPBI 445.

PQHS 466. Promoting Health Across Boundaries. 3 Units.
This course examines the concepts of health and boundary spanning and how the synergy of the two can produce new, effective approaches to promoting health. Students will explore and analyze examples of individuals and organizations boundary spanning for health to identify practice features affecting health, compare and contrast practices and approaches, and evaluate features and context that promote or inhibit boundary spanning and promoting health. Offered as MPHP 466, PQHS 466, SOCI 466, NURS 466 and BETH 466. Prereq: Graduate student status or instructor consent.

PQHS 467. Comparative and Cost Effectiveness Research. 1 Unit.
Comparative effectiveness research is a cornerstone of healthcare reform. It holds the promise of improved health outcomes and cost containment. This course is presented in a convenient 5-day intensive format in June. There are reading assignments due prior to the 1st session. Module A, Days 1-2: Overview of comparative effectiveness research (CER) from a wide array of perspectives: individual provider, institution, insurer, patient, government, and society. Legal, ethical and social issues, as well as implications for population and public health, including health disparities will also be a component. Module B, Day 3: Introduction to the various methods, and their strengths, weaknesses and limitations. How to read and understand CER papers. Module C, Days 4-5: Cost-Effectiveness Analysis. This will cover costing, cost analysis, clinical decision analysis, quality of life and cost-effectiveness analysis for comparing alternative health care strategies. Trial version of TreeAge software will be used to create and analyze a simple cost-effectiveness model. The full 3-credit course is for taking all 3 modules. Modules A or C can be taken alone for 1 credit. Modules A and B or Modules B and C can be taken together for a total of 2 credits. Module B cannot be taken alone. If taking for 2 or 3 credits, some combination of term paper, project and/or exam will be due 30 days later. Offered as PQHS 467 and MPHP 467.

PQHS 468. The Continual Improvement of Healthcare: An Interdisciplinary Course. 3 Units.
This course prepares students to be members of interprofessional teams to engage in the continual improvement in health care. The focus is on working together for the benefit of patients and communities to enhance quality and safety. Offered as PQHS 468, MPHP 468, and NURS 468.

PQHS 471. Machine Learning & Data Mining. 3 Units.
Vast amount of data are being collected in medical and social research and in many industries. Such big data generate a demand for efficient and practical tools to analyze the data and to identify unknown patterns. We will cover a variety of statistical machine learning techniques (supervised learning) and data mining techniques (unsupervised learning), with data examples from biomedical and social research. Specifically, we will cover prediction model building and model selection (shrinkage, Lasso), classification (logistic regression, discriminant analysis, k-nearest neighbors), tree-based methods (bagging, random forests, boosting), support vector machines, association rules, clustering and hierarchical clustering. Basic techniques that are applicable to many of the areas, such as cross-validation, the bootstrap, dimensionality reduction, and splines, will be explained and used repeatedly. The field is fast evolving and new topics and techniques may be included when necessary. Prereq: PQHS/EPBI 431.

PQHS 480. Introduction to Mathematical Statistics. 3 Units.
An introduction to statistical inference at an intermediate mathematical level. The concepts of random variables and distributions, discrete and continuous, are reviewed. Topics covered include: expectations, variance, moments, the moment generating function; Bernoulli, binomial, hypergeometric, Poisson, negative binomial, normal, gamma and beta distribution; the central limit theorem; Bayes estimation, maximum likelihood estimators, unbiased estimators, sufficient statistics; sampling distributions (chi-square, t) confidence intervals, Fisher information; hypothesis testing, uniformly most powerful tests and multi-decision problems. Prereq: MATH 122, MATH 124 or MATH 126.
PQHS 481. Theoretical Statistics I. 3 Units.
Topics provide the background for statistical inference. Random variables; distribution and density functions; transformations, expectation. Common univariate distributions. Multiple random variables; joint, marginal and conditional distributions; hierarchical models, covariance. Distributions of sample quantities, distributions of sums of random variables, distributions of order statistics. Methods of statistical inference. Offered as STAT 345, STAT 445, and PQHS 481. Prereq: MATH 122 or MATH 223 or Coreq: PQHS/EPBI 431.

PQHS 482. Theoretical Statistics II. 3 Units.
Point estimation: maximum likelihood, moment estimators. Methods of evaluating estimators including mean squared error, consistency, "best" unbiased and sufficiency. Hypothesis testing; likelihood ratio and union-intersection tests. Properties of tests including power function, bias. Interval estimation by inversion of test statistics, use of pivotal quantities. Application to regression. Graduate students are responsible for mathematical derivations, and full proofs of principal theorems. Offered as STAT 346, STAT 446 and PQHS 482. Prereq: STAT 345 or STAT 445 or PQHS/EPBI 481.

PQHS 484. Global Health Epidemiology. 1 - 3 Units.
This course provides a rigorous problem-centered training in the epidemiology, prevention, treatment, and control of infectious diseases and, more generally, global health. This is an advanced epidemiology that embraces an active learning environment. Students are expected to invest time out of the classroom reading and working with classmates. Classes will be conducted with discussions, debates, group projects, and group presentations. By taking this course, students will develop a framework for interpreting, assessing, and performing epidemiologic research on issues of global importance. The course will be divided into three modules: 1) Global Health Epidemiology 2) Helminth Epidemiology, and 3) Epidemiology of Disease Elimination. Each module is worth 1 credit hour and may be taken separately. Each module will have a separate project and/or exam. The final exam time will be used for group presentations and panel discussion. Active class participation is required through discussions, case studies, and group projects. Offered as PQHS 484, INTH 484, and MPHP 484.

PQHS 490. Epidemiology: Introduction to Theory and Methods. 3 Units.
This course provides an introduction to the principles of epidemiology covering the basic methods necessary for population and clinic-based research. Students will be introduced to epidemiologic study designs, measures of disease occurrence, measures of risk estimation, and casual inference (bias, confounding, and interaction) with application of these principles to specific fields of epidemiology. Classes will be a combination of lectures, discussion, and in-class exercises. It is intended for students who have a basic understanding of the principals of human disease and statistics. Offered as PQHS 490 and MPHP 490. Prereq or Coreq: PQHS/EPBI 431 or Requisites Not Met permission.

PQHS 494. Infectious Disease Epidemiology. 3 Units.
This course focuses on tuberculosis (TB) and HIV epidemiology, including perspectives on these diseases in the US and globally. It is a follow-up to PQHS/MPHP 484: Global Health Epidemiology, but these courses do not necessarily need to be taken in sequence. This is an advanced course, focusing on methods and approaches in epidemiology and public health. Offered as PQHS 494, INTH 494 and MPHP 494. Prereq: PQHS/EPBI 490.

PQHS 499. Independent Study. 1 - 18 Units.
PQHS 500. Design and Analysis of Observational Studies. 3 Units.
An observational study investigates treatments, policies or exposures and the effects that they cause, but it differs from an experiment because the investigator cannot control assignment. We introduce appropriate design, data collection and analysis methods for such studies, to help students design and interpret their own studies, and those of others in their field. Technical formalities are minimized, and the presentations will focus on the practical application of the ideas. A course project involves the completion of an observational study, and substantial use of the R statistical software. Topics include randomized experiments and how they differ from observational studies, planning and design for observational studies, adjustments for overt bias, sensitivity analysis, methods for detecting hidden bias, and focus on propensity score methods for selection bias adjustment, including multivariate matching, stratification, weighting and regression adjustments. Recommended preparation: a working knowledge of multiple regression, some familiarity with logistic regression, with some exposure to fitting regression models in R. Offered as CRSP 500 and PQHS 500.

PQHS 501. Research Seminar. 0 Unit.
This seminar series includes faculty and guest-lecturer presentations designed to introduce students to on-going research at the University and elsewhere. Seminars will emphasize the application of methods learned in class, as well as the introduction of new methods and tools useful in research.

PQHS 504. Seminar in Health Care Organization, Outcomes and Policy. 0 Unit.
This seminar is designed to enhance the professional development of students in the Health Care Organization, Outcomes and Policy concentration of the Department of Epidemiology and Biostatistics and provide them with practical information, experiences and guidance to foster their academic success. Students will 1) develop the ability to critically appraise the health services research literature; 2) gain experience in organizing and delivering oral presentations based on published literature and their own research endeavors; 3) be exposed to role models and receive coaching on career development through lecture and discussion involving experienced faculty from within and outside the division; 4) receive didactic training and hands-on experience with career-related tasks and skills such as grant writing and proposal evaluation, article review, and effective participation in professional meetings; and hear faculty from within and outside the department describe their research. The specific content of the seminar for any given semester will be determined jointly by HCOP students and faculty. Enrollment is limited to students in the HCOP division of the Department of Epidemiology and Biostatistics.

PQHS 505. Seminar in Global Health Epidemiology. 0 Unit.
This seminar series examines a broad range of topics related to infectious disease research in international settings. Areas of interest are certain to include epidemiology, bioethics, medical anthropology, pathogenesis, drug resistance, vector biology, cell and molecular biology, vaccine development, diagnosis, and socio-cultural factors contributing to or compromising effective health care delivery in endemic countries. Speakers will include a diverse group of regional faculty and post-doctoral trainees, as well as visiting colleagues from around the world. Students will be asked to read a journal article written by the speaker and then discuss this article with the speaker after their seminar.
PQHS 506. Seminar in Health Behavior and Prevention Research. 0 Unit. This seminar is designed to enhance the academic and professional development of students in the Health Behavior & Prevention Research (HB&PR) concentration in the Department of Epidemiology and Biostatistics. The seminar is comprised of a journal club style in which current and classic research literature in health behavior and prevention research is critically evaluated. Also, talks are given by students, faculty, and invited guests. These activities give students the opportunity to improve their ability to: 1) critically evaluate research literature in HB&PR; 2) lead effectively a discussion of a research article; and 3) organize and deliver oral presentations based on published literature and their own research endeavors. Some sessions are devoted to didactic training and hands-on experience with career-related tasks and skills such as grant writing, proposal evaluation, and manuscript review. The specific content of the seminar for any given semester will be determined jointly by the students and faculty in HB&PR. Enrollment is required of all PhD students in the HB&PR concentration of the Department of Epidemiology and Biostatistics; however is open to all interested students.

PQHS 510. Health Disparities. 3 Units. This course aims to provide theoretical and application tools for students from many disciplinary backgrounds to conduct research and develop interventions to reduce health disparities. The course will be situated contextually within the historical record of the United States, reviewing social, political, economic, cultural, legal, and ethical theories related to disparities in general, with a central focus on health disparities. Several frameworks regarding health disparities will be used for investigating and discussing the empirical evidence on disparities among other subgroups (e.g., the poor, women, uninsured, disabled, and non-English speaking populations) will also be included and discussed. Students will be expected to develop a research proposal (observational, clinical, and/or intervention) rooted in their disciplinary background that will incorporate materials from the various perspectives presented throughout the course, with the objective of developing and reinforcing a more comprehensive approach to current practices within their fields. Offered as CRSP 510, PQHS 510, MPHP 510, NURS 510, and SASS 510.

PQHS 515. Secondary Analysis of Large Health Care Data Bases. 3 Units. Development of skills in working with the large-scale secondary data bases generated for research, health care administration/billing, or other purposes. Students will become familiar with the content, strength, and limitations of several data bases; with the logistics of obtaining access to data bases; the strengths and limitations of routinely collected variables; basic techniques for preparing and analyzing secondary data bases and how to apply the techniques to initiate and complete empirical analysis. Recommended preparation: PQHS/EPBI 414 or equivalent; PQHS/EPBI 431 or PQHS/EPBI 460 and PQHS/EPBI 461 (for HSR students).

PQHS 550. Meta-Analysis & Evidence Synthesis. 2 - 3 Units. Systematic reviews use reproducible methods to systematically search the literature and synthesize the results of a specific topic area. Meta-analysis is a specific analytic technique used to pool results of individual studies. Systematic reviews are useful ways to establish one's knowledge in a particular field of study, and can highlight gaps in research which can be pursued in future work. They can also inform the background of a grant. This course is designed to introduce students to the methods of conducting a high quality systematic review and meta-analysis of intervention studies. We will cover the design, methods, and analytic techniques involved in systematic reviews. These concepts will prepare students to conduct their own systematic review or evaluate the systematic reviews of others. Sessions will be lectures, labs, and presentations. Topics include developing a search strategy, abstracting key data, synthesizing the results qualitatively, meta-analytic techniques, grading the quality of studies, grading the strength of the evidence, and manuscript preparation specific to systematic reviews and meta-analysis of intervention studies. Caveat: If you would like to conduct a systematic review of your own that can be published after the course ends, you will need to have several other class members or colleagues willing to work with you on the project. The systematic review should be on a topic where you expect no more than 20-30 included studies in order to be able to complete the review soon after the course ends. Offered as CRSP 550 and PQHS 550. Prereq: CRSP 401, PQHS/EPBI 431, MPHP 405, NURS 532 or Requisites Not Met permission.

PQHS 601. Master's Project Research. 1 - 18 Units.

PQHS 602. Practicum. 1 - 3 Units. This course focuses on the skills needed to become an effective statistical consultant. The course objectives are: to learn the role of the consulting statistician and the accompanying responsibilities and ethical considerations, to develop the ability to interact with clients and elicit the information required to provide consulting expertise, to learn general strategies for approaching consulting problems that can be applied to a wide range of problems in medical areas, and to develop expertise in areas needed by the consulting biostatistician. These include database architecture, data quality control, record keeping for potential audits, statistical techniques, and report generation.

PQHS 651. Thesis M.S.. 1 - 18 Units.

PQHS 701. Dissertation Ph.D.. 1 - 9 Units. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

School of Medicine Faculty

School of Medicine

Full-Time Faculty

Anatomy
Thomas Brantley, MD; Assistant Professor
Darin Croft, PhD; Professor
Barbara Freeman, PhD; Assistant Professor
Michael Katz, MD PhD; Associate Professor
Hue-Lee Kaung, PhD; Associate Professor
Joseph Miller, PhD; Associate Professor
Scott Simpson, PhD; Professor
Bryan Singelyn, MS; Instructor
Susanne Wish-Baratz, PhD; Assistant Professor

Biochemistry
Amiya Banerjee, PhD; Professor
Barbara Bedogni, PhD; Associate Professor
Paul Carey, PhD; Professor
Hung-Ying Kao, PhD; Professor
William Merrick, PhD; Professor
Nelson Phillips, PhD; Associate Professor
Marianne Pusztai-Carey, PhD; Associate Professor
David Samols, PhD; Professor
Menachem Shoham, PhD; Associate Professor
Martin Snider, PhD; Associate Professor
Focco Van den Akker, PhD; Associate Professor
Michael Weiss, MD PhD; Professor
Yanwu Yang, PhD; Assistant Professor
Vivien Yee, PhD; Associate Professor

Bioethics
Eileen Anderson-Fye, EdD; Associate Professor
Mark Aulisio, PhD; Professor
Nicole Deming, JD; Assistant Professor
Monica Gerrek, PhD; Assistant Professor
Aaron Goldenberg, PhD; Associate Professor
Insoo Hyun, PhD; Associate Professor
Sana Loue, PhD; Professor
Patricia Marshall, PhD; Professor
Suzanne Rivera, PhD; Assistant Professor
Stuart Youngner, MD; Professor

Biomedical Engineering
A. Ajiboye, PhD; Assistant Professor
Eben Alsberg, PhD; Professor
James Anderson, MD PhD; Professor
James Basilion, PhD; Professor
Jeffrey Capadona, Ph.D.; Associate Professor
Colin Drummond, PhD MBA; Professor
Jeffrey Duerk, PhD; Professor
Dominique Durand, PhD; Professor

Steven Eppell, PhD; Associate Professor
Miklos Gratzi, MS; Associate Professor
Kenneth Gustafson, PhD; Associate Professor
Efstatios Karathanasis, PhD; Associate Professor
Robert Kirsch, PhD; Professor
Zheng-Rong Lu, PhD; Professor
Anant Madabhushi, PhD; Professor
Cameron McIntyre, PhD; Professor
P. Peckham, PhD; Professor
Andrew Rollins, PhD; Professor
Gerald Saidel, PhD; Professor
Nicole Seiberlich, PhD; Associate Professor
Anirban Sen, PhD; Associate Professor
Sam Senyo, PhD; Assistant Professor
Nicole Steinmetz, PhD; Associate Professor
Pallavi Tiwari, PhD; Assistant Professor
Dustin Tyler, PhD; Professor
Satish Viswanath, PhD; Assistant Professor
Horst von Recum, PhD; Professor
David Wilson, PhD; Professor
Xin Yu, Sc.D.; Professor

Division of General Medical Sciences
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Danny Manor, PhD; Associate Professor
Masaru Miyagi, PhD; Associate Professor
Michelle Puchowicz, PhD; Associate Professor
Tamara Randall, MS RDN LD; Instructor
Joan Schenkel, MS; Instructor
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James Swain, PhD; Associate Professor
Cheryl Thompson, PhD; Assistant Professor
John Tilton, MD; Associate Professor
Rosanna Watowicz, PhD; Assistant Professor
Sichun Yang, PhD; Assistant Professor

Pathology
Derek Abbott, MD PhD; Professor
Stanley Adoro, PhD; Assistant Professor
Cheryl Cameron, Ph.D.; Instructor
Shu Guang Chen, PhD; Associate Professor
Brian Cobb, PhD; Professor
XingJun Fan, PhD; Assistant Professor
Pierluigi Gambetti, MD; Professor
Wendy Goodman, PhD; Instructor
Clive Hamlin, PhD; Associate Professor
Clifford Harding, MD PhD; Professor
Mark Jackson, PhD; Associate Professor
Mark Jones, PhD; Instructor
Qingzhong Kong, PhD; Associate Professor
M. Medof, MD PhD; Professor
Vincent Monnier, MD; Professor
Silvio Notari, PhD; Instructor
Theresa Pizarro, PhD; Professor
Prameswaran Ramakrishnan, PhD; Assistant Professor
Jiri Safar, MD; Professor
Rafick-Pierre Sekaly, PhD; Professor
David Sell, PhD; Assistant Professor
Supriya Shukla, PhD; Instructor
Neena Singh, MD, PhD; Professor
Man-Sun Sy, PhD; Professor
Alan Tartakoff, PhD; Professor
Wenzhang Wang, PhD; Instructor
Xinglong Wang, Ph.D.; Assistant Professor
Pamela Wearsch, PhD; Assistant Professor
Tsan Xiao, PhD; Associate Professor
Xiongwei Zhu, PhD; Professor
Nicholas Ziets, PhD; Professor
Wenquan Zou, MD PhD; Associate Professor

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W. John Durfee, DVM; Assistant Professor
Marcin Golczak, PhD; Assistant Professor
Yoshikazu Imanishi, PhD; Associate Professor
Beata Jaszczybska, PhD; Assistant Professor
Ruth Keri, PhD; Professor
Philip Kiser, PhD; Assistant Professor
Paul MacDonald, PhD; Professor
Rachel Mann, PhD; Instructor
Jason Mears, PhD; Assistant Professor
Vera Moiseenkova-Bell, PhD; Associate Professor
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Derek Taylor, PhD; Associate Professor
Johannes von Lintig, PhD; Associate Professor
Amy Wilson-Delfosse, PhD; Professor
You-Wei Zhang, PhD; Associate Professor

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Matthias Buck, PhD; Professor
Sudha Chakrapani, PhD; Associate Professor
George Dubyak, PhD; Professor
Christopher Ford, PhD; Associate Professor
Joan Fox, PhD; Professor
Jeffrey Garvin, PhD; Professor
Stephen Jones, PhD; Professor
Joseph LaManna, PhD; Professor
Fraser Moss, PhD; Instructor
Tingwei Mu, PhD; Assistant Professor
Rossana Occhipinti, PhD; Instructor
Xin Qi, Ph.D.; Associate Professor
Rajesh Ramachandran, PhD; Assistant Professor
Andrea Romani, MD PhD; Associate Professor
William Schilling, PhD; Professor
Corey Smith, PhD; Professor
Julian Stelzer, PhD; Associate Professor
Witold Surewicz, PhD; Professor
Kui Xu, MD; Instructor

**Population & Quantitative Health Sciences**
Jeffrey Albert, PhD; Professor
Paul Baaki, Ph.D. MBBCH; Instructor
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Farren Briggs, PhD; Assistant Professor
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Sheldon Rose, MD; Clinical Instructor
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**Environmental Health Sciences**
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Iwona Yike, PhD; Adjunct Assistant Professor

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Daniel Allan, MD; Clinical Assistant Professor
Dale Angerman, MD; Clinical Assistant Professor
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Dale Balkovec, DO; Clinical Assistant Professor
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Richard Devans, MD; Clinical Assistant Professor
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<tr>
<td>Yaser Al-Marrawi, MD</td>
<td>Clinical Instructor</td>
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<tr>
<td>Nadim Al-Mubarak, MD</td>
<td>Clinical Assistant Professor</td>
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<td>Anil Anumandla, MBBS</td>
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<td>Evamaria Anvari, MD</td>
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<td>Kristen Arseneau, MS</td>
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<td>Mehrdad Asgeri, MD</td>
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<td>Nuzhat Ashai, MD</td>
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<td>Craig Asher, MD</td>
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<td>Mahi Ashwath, MBBS</td>
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<td>Arman Askari, MD</td>
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<td>Omobayonle Ayanleke, MB BS</td>
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<td>Nabil Azar, MD</td>
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<td>Haitham Azem, MD</td>
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<td>Carolina Aziz, DO</td>
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<td>Saqib Aziz, MD</td>
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<tr>
<td>Samia Baaklini, MD</td>
<td>MD; Clinical Instructor</td>
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<td>Mohan Bafna, MD</td>
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Sandhya Varyani, MD; Clinical Instructor
Vivian von Gruenigen, MD; Adjunct Associate Professor
Thaddeus Waters, MD; Clinical Assistant Professor
Rachel Weinerman, MD; Clinical Assistant Professor
Margie Wenz, MD; Clinical Instructor
Mistie Winkfield, MSN; Clinical Assistant Professor
Nancy Wollam-Huhn, MD; Clinical Instructor
C.K. Woo, MD; Clinical Instructor
Charles Zonfa, MD; Clinical Instructor

Surgery

Tom Abelson, MD; Clinical Associate Professor
Badih Adada, MD; Clinical Assistant Professor
Joseph Africa, MD; Clinical Assistant Professor
Rami Akhrass, MD; Clinical Assistant Professor
Olufemi Akindipe, MD; Clinical Assistant Professor
Gilberto Alemar, MD; Clinical Assistant Professor
Zahraa Al-Hilli, MBBch; Clinical Assistant Professor
Nima Almassi, MD; Clinical Instructor
Javier Alvarez-Tostado, MD; Clinical Assistant Professor
Michael E. Anderson, MD; Clinical Assistant Professor
George Anton, MD; Clinical Assistant Professor
Gabriel Arevalo, MD; Clinical Instructor
Luis Argote-Greene, MD; Clinical Assistant Professor
Sofya Asfaw, MD; Clinical Instructor
Jean Ashburn, MD; Clinical Assistant Professor
Kathleen Ashton, PhD; Clinical Assistant Professor
Marjan Attaran, MD; Clinical Assistant Professor
Toms Augustin, MBBS; Clinical Assistant Professor
Khalil Azem, MD; Clinical Assistant Professor
Rebecca Bagley, MD; Clinical Assistant Professor
Naveen Balasundaram, MBBS; Clinical Instructor
George Balis, MD; Clinical Assistant Professor
Steven Ball, MD; Clinical Assistant Professor
Timothy Barnett, MD; Clinical Assistant Professor
Barbara Ercole, MD; Clinical Assistant Professor
Pedro Escobar, MD; Clinical Associate Professor
Peter Evans, MD PhD; Clinical Assistant Professor
Lourdes Falconi, MD; Clinical Assistant Professor
Alicia Fanning, MD; Clinical Assistant Professor
Amr Fergany, MD; Clinical Assistant Professor
Amanda Ferry, MD; Clinical Assistant Professor
Gretchen Fisher, MD; Clinical Assistant Professor
Richard Freeman, MD PhD; Clinical Associate Professor
Mary Freyvogel, DO; Clinical Assistant Professor
David Friedman, MD; Clinical Assistant Professor
Charlotte Fries, MSN; Adjunct Instructor
Mark Froimson, MD; Clinical Assistant Professor
Jonathan Funk, MD; Clinical Assistant Professor
Bishoy Gad, MD; Clinical Instructor
William Gans, MD; Clinical Assistant Professor
Thomas Garofalo, MD; Clinical Assistant Professor
Katie Geelan-Hansen, MD; Clinical Instructor
Rick Gemma, DO; Clinical Assistant Professor
Jason Genin, DO; Clinical Assistant Professor
Joseph George, MD; Clinical Assistant Professor
Islam Ghoneim, MD; Clinical Assistant Professor
Neil Gibson, MD; Clinical Instructor
Bradley Gill, MD; Clinical Instructor
Gregory Gilot, MD; Clinical Assistant Professor
Margaret Gilot, MD; Clinical Assistant Professor
Julie Girzhel, MD; Clinical Assistant Professor
Habibeh Gitiforooz, MD; Clinical Assistant Professor
Kathryn Goebel, MD; Clinical Assistant Professor
Amitabh Goel, MD; Clinical Professor
Michael Gong, MD PhD; Clinical Assistant Professor
Jennifer Goodman, DPM; Clinical Instructor
Ihya Gorgun, MD; Clinical Assistant Professor
Loinel Gottschalk, MD; Clinical Instructor
Thomas Graham, MD; Clinical Assistant Professor
Daniel Greene, MD; Clinical Instructor

David Gurd, MD; Clinical Assistant Professor
Jesse Gutnick, MD; Clinical Instructor
Richard Guttman, MD; Clinical Assistant Professor
Georges-Pascal Haber, MD, PhD; Clinical Assistant Professor
Betty Haberkamp, DDS; Clinical Assistant Professor
Thomas Haberkamp, MD; Clinical Assistant Professor
Lawrence Hakim, MD; Clinical Assistant Professor
M. Halbreiner, MD; Clinical Instructor
Amer Hanano, MD; Clinical Assistant Professor
Anastasios Hantzakos, MD; Clinical Assistant Professor
Mark Hardy, DPH; Clinical Instructor
Waleed Hassen, MD; Clinical Associate Professor
Samuel Haywood, MD; Clinical Instructor
Nader Hebela, MD; Clinical Associate Professor
Mark Hendrickson, MD; Clinical Assistant Professor
Christopher Herbert, DPM; Clinical Assistant Professor
Robert Hermann, MD; Clinical Professor
Gina Hild, DPM; Clinical Assistant Professor
Bryan Hinck, MD; Clinical Instructor
Jason Ho, MD; Clinical Instructor
Carrie Hood, MD; Clinical Assistant Professor
Brandon Hopkins, MD; Clinical Assistant Professor
Anne Hseu, MD; Clinical Instructor
Eric Hurtado, MD; Clinical Assistant Professor
John Iafelice, MD; Adjunct Instructor
Raymond Isakov, MD; Clinical Assistant Professor
Brandon Isariyawongse, MD; Clinical Instructor
Pascal Jarjoura, MD; Clinical Assistant Professor
John Jasper, MD; Clinical Assistant Professor
Majida Jassani, MD; Clinical Associate Professor
Joan Jesse, MD; Clinical Assistant Professor
Douglas Johnston, MD; Clinical Instructor
Morgan Jones, MD MPH; Clinical Assistant Professor
David Joyce, MD; Clinical Instructor
Michael Joyce, MD; Clinical Associate Professor
Timothy Joyce, MD; Clinical Instructor
Jeanwan Kang, MD; Clinical Assistant Professor
Georgios Karagkounis, MD; Clinical Instructor
Lynnette Karth, MD; Clinical Assistant Professor
Ganesh Kartha, MD; Clinical Instructor
Daniel Kassavin, MD; Clinical Assistant Professor
Robert Katz, MD; Clinical Professor
Kripa Kavasseri, MD; Clinical Assistant Professor
Rebecca Kelso, MD; Clinical Assistant Professor
Rosanne Kho, MD; Clinical Assistant Professor
Fadi Khoury, MD; Clinical Assistant Professor
Howard Kimmel, MD; Clinical Senior Instructor
Bogdan Kindzelski, MD; Clinical Instructor
Terry King, MD; Clinical Assistant Professor
Lee Kirksey, MD; Clinical Assistant Professor
John Klein, MD; Clinical Instructor
Matthew Klos, PhD; Clinical Instructor
Thomas Knackstedt, MD; Clinical Assistant Professor
Joel Kolmodin, MD; Clinical Instructor
Meredith Konya, MD; Clinical Assistant Professor
Marijan Koprivanac, MD; Clinical Instructor
Alexander Kotlyar, MD; Clinical Instructor
David Kovacevic, MD; Clinical Instructor
David Krahe, DO; Clinical Assistant Professor
Viktor Krebs, MD; Clinical Assistant Professor
Jayram Krishnan, DO; Clinical Assistant Professor
Thomas Kuivila, MD; Clinical Assistant Professor
Norman Kumins, MD; Clinical Assistant Professor
Neilenu Kundu, MD; Clinical Instructor
Donald Kushner, MD; Clinical Senior Instructor
Joseph Lahorra, MD; Clinical Assistant Professor
Ching-Feng Lai, DO; Clinical Assistant Professor
Eric Lamarre, MD; Clinical Instructor
Patrick Landers, DPM; Clinical Instructor
James Lane, MD; Clinical Assistant Professor
Mary Laplante, MD; Clinical Assistant Professor
Byron Lee, MD PhD; Clinical Assistant Professor

Jai Lee, MD; Clinical Assistant Professor
Brian Leo, MD; Clinical Assistant Professor
Melissa Levack, MD; Clinical Instructor
David Levy, MD; Clinical Associate Professor
Edward Levy, MD; Clinical Assistant Professor
Pamela Li, MD; Clinical Assistant Professor
Hanna Lisbona, MD; Clinical Assistant Professor
Christopher Litts, MD; Clinical Assistant Professor
Emanuele Lo Menzo, MD, PhD; Clinical Assistant Professor
Gabriel Loo, MD; Clinical Instructor
David Lott, MD; Clinical Instructor
Jennifer Lucas, MD; Clinical Assistant Professor
Sanford Luria, MD; Clinical Assistant Professor
Adam Mace, MD; Clinical Instructor
Ramon Malaya, MD; Clinical Assistant Professor
James Malgieri, MD; Clinical Assistant Professor
Sharon Marcanthony, MD; Clinical Assistant Professor
Patrick Marinello, MD; Clinical Instructor
Alan Markowitz, MD; Clinical Assistant Professor
David Maron, MD; Clinical Assistant Professor
Steven Maschke, MD; Clinical Assistant Professor
Claudia Mason, MD; Clinical Assistant Professor
Anthony Matalavage, DPM; Clinical Instructor
Daniel Mayer, DO; Clinical Assistant Professor
Tara McElroy, MD; Clinical Assistant Professor
Thomas McGrew, MD; Clinical Assistant Professor
Erin McKelvey, MD; Clinical Assistant Professor
Michael Medina, MD; Clinical Assistant Professor
Miguel Medina, MD; Clinical Assistant Professor
Gita Mehta, MBBS; Clinical Assistant Professor
Jon Meine, MD; Clinical Assistant Professor
James Merlino, MD; Clinical Assistant Professor
Mila Korska, MD; Clinical Instructor
Mena Mesija, MD; Clinical Instructor
Daniel Mesko, DO; Clinical Instructor
Sharon Mikol, MD; Clinical Assistant Professor
School of Medicine Faculty

Susan Mlijkovic-Goodrich, MD; Clinical Assistant Professor
Jill Minger, MD; Clinical Assistant Professor
Sara Miniaci-Coxhead, MD; Clinical Assistant Professor
Suhael Momin, MD; Clinical Instructor
Rosebel Monteiro, MD; Clinical Assistant Professor
Andrea Moreira, MD; Clinical Assistant Professor
Ryan Mori, MD; Clinical Instructor
Gareth Morris-Stiff, MBCh; Clinical Assistant Professor
Thomas Mroz, MD; Clinical Assistant Professor
Kevin Muise, MD; Clinical Assistant Professor
Amani Munshi, MD; Clinical Assistant Professor
Nicolas Muruve, MD; Clinical Assistant Professor
Sumon Nandi, MD; Clinical Instructor
Martin Newman, MD; Clinical Assistant Professor
Kathryn Newton, MD; Clinical Assistant Professor
Robert Nickodem, Jr., MD; Clinical Assistant Professor
Juan Nogueras, MD; Clinical Assistant Professor
Edward Nowicki, MD; Clinical Associate Professor
Yaw Nyame, MD; Clinical Instructor
William O'Brien, MD; Clinical Assistant Professor
Timothy O'Donnell, MD; Clinical Assistant Professor
Patrick O'Hara, MD; Clinical Professor
Thomas Olbrych, MD; Clinical Assistant Professor
Omar Ortiz-Alvarado, MD; Clinical Assistant Professor
R. Orr, MD; Clinical Assistant Professor
George Ozbaradakci, MD; Clinical Assistant Professor
Tammy Parker, MD; Clinical Assistant Professor
Jeffrey Parks, MD; Clinical Instructor
Mita Patel, MD; Clinical Assistant Professor
Betsy Patterson, MD; Clinical Assistant Professor
Thomas Patterson, PhD; Adjunct Assistant Professor
Daniel Peabody, MD; Clinical Assistant Professor
Sotero Peralta, MD; Clinical Assistant Professor
Tiffany Perry, MD; Clinical Assistant Professor
Yaron Perry, MD; Clinical Associate Professor
James Persky, MD; Clinical Assistant Professor
Barry Peskin, MD; Clinical Assistant Professor
Julian Peskin, MBBS; Clinical Assistant Professor
Erica Peters, MD; Clinical Assistant Professor
Roland Philip, MD; Clinical Assistant Professor
Thomas Picklow, MD; Clinical Assistant Professor
Bradley Pierce, MD; Clinical Assistant Professor
J. Vicente Poblete, MD; Clinical Assistant Professor
Christine Poblete-Lopez, MD; Clinical Assistant Professor
James Poliquin, MD; Clinical Assistant Professor
Arthur Porter, MD; Clinical Assistant Professor
Fabio Potenti, MD; Clinical Assistant Professor
Debra Pratt, MD; Clinical Assistant Professor
Naftali Presser, MD; Clinical Instructor
Brian Putka, MD; Clinical Assistant Professor
Laura Rabinowitz, MD; Clinical Assistant Professor
Prasanta Raj, MBBS; Clinical Associate Professor
Rachel Randall, MD; Clinical Instructor
Sudhakar Rao, MD; Clinical Assistant Professor
Colleen Raymond, MD; Clinical Assistant Professor
Daniel Raymond, MD; Clinical Assistant Professor
Vicki Reed, MD; Clinical Assistant Professor
Jean Reinhold, MD; Clinical Assistant Professor
Peter Revenaugh, MD; Clinical Instructor
Stephanie Ricci, MD; Clinical Assistant Professor
Jeffrey Robbins, MD; Clinical Assistant Professor
Scott Robertson, MD; Clinical Assistant Professor
Lisa Rock, MD; Clinical Instructor
John Rodriguez, MD; Clinical Assistant Professor
L. Leonardo Rodriguez, MD; Clinical Assistant Professor
Warren Rose, MD; Clinical Assistant Professor
Eric Roselli, MD; Clinical Assistant Professor
Lester Rosen, MD; Clinical Assistant Professor
Raul Rosenthal, MD; Clinical Assistant Professor
Florian Roser, MD PhD; Clinical Professor
Richard Roski, MD; Clinical Assistant Professor
Allen Roth, MD; Clinical Assistant Professor
James Ruda, MD; Clinical Instructor
Jonathon Russell, MD; Clinical Instructor
Rebecca Russell, MD; Clinical Assistant Professor
Andrew Russman, DO; Clinical Assistant Professor
Barbara Saar, DPM; Clinical Instructor
William Saar, DPM; Clinical Assistant Professor
Vani Sabesan, MD; Clinical Assistant Professor
Frank Sabo, MD; Clinical Assistant Professor
John Salamone, DPM; Clinical Instructor
Abdelaziz Saleh, MBBC; Clinical Professor
Muhammad Salman, MD; Clinical Assistant Professor
Michael Samotowka, MD; Clinical Assistant Professor
Mary Samplaski, MD; Clinical Instructor
James Sampliner, MD; Clinical Professor
Dana Sands, MD; Clinical Assistant Professor
Bashir Sankari, MD; Clinical Assistant Professor
Thomas Santoscoy, MD; Clinical Assistant Professor
Edward Savage, MD; Clinical Professor
Jason Savage, MD; Clinical Associate Professor
Abraham Sayon, MD; Clinical Instructor
Joseph Scarcella, MD; Clinical Assistant Professor
Michael Scarcella, MD; Clinical Instructor
Paula Schaffer-Polakof, MD; Clinical Instructor
Maria Schleicher, MD; Clinical Assistant Professor
Frederick Schmieder, DPM; Clinical Instructor
Gabriel Schnickel, MD; Clinical Assistant Professor
Scott Seidel, DO; Clinical Instructor
Francesco Serino, MD; Clinical Professor
Alfred Serna, MD; Clinical Assistant Professor
Sebouh Setrakian, MD; Clinical Assistant Professor
Anup Shah, MD; Clinical Instructor
Mihir Shah, MD; Clinical Instructor
Samir Shah, MD; Clinical Instructor
Kaushal Shah, MD; Clinical Assistant Professor
David Shapiro, MD; Clinical Assistant Professor
Sarah Share, MD; Clinical Assistant Professor
Alok Shrivastava, MBBS; Clinical Assistant Professor
Shafik Sidani, MD; Clinical Assistant Professor
Anne Sierk, MD; Clinical Assistant Professor
Neil Sika, O.D.; Clinical Senior Instructor
Conrad Simpfendorfer, MD; Clinical Assistant Professor
Ashley Simpson, DO; Clinical Assistant Professor
Lynn Simpson, MD; Clinical Assistant Professor
Raj Sindwani, MD; Clinical Assistant Professor
Scott Slavis, MD; Clinical Assistant Professor
Andrew Smith, MD; Clinical Assistant Professor
Armine Smith, MD; Clinical Instructor
Keisha Smith, MD; Clinical Assistant Professor
Edward Soltesz, MD; Clinical Assistant Professor
David Shapiro, MD; Clinical Assistant Professor
Dina Stock, DPM; Clinical Assistant Professor
Womack Stokes, MD; Clinical Assistant Professor
Juan Suarez, MD; Clinical Assistant Professor
Andrew Sun, MD; Clinical Instructor
Luay Susan, MBBC; Clinical Assistant Professor
Sharom Sutherland, MD; Clinical Assistant Professor
Monica Svets, MD; Clinical Assistant Professor
Samuel Szomstein, MD; Clinical Assistant Professor
Hideo Takahashi, MD; Clinical Instructor
Dennis Tang, MD; Clinical Instructor
Julierut Tantibhedhyangkul, MD; Clinical Assistant Professor
Mary Taylor, MD; Clinical Assistant Professor
Anil Thomas, MD; Clinical Instructor
Anthony Tizzano, MD; Clinical Assistant Professor
Mindy Toabe, OD; Clinical Senior Instructor
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Andreas Tzakis, MD, PhD; Clinical Assistant Professor
Yuji Umeda, MD, PhD; Clinical Assistant Professor
Raman Unnikrishnan, MD; Clinical Instructor
Sneha Vaish, MD; Clinical Assistant Professor
Nakul Vakil, MD; Clinical Instructor
Jennifer VandeVelde, DO; Clinical Assistant Professor
Donna Vecchione, MD; Clinical Senior Instructor
Dominic Venne, MD; Clinical Associate Professor
Mark Verdun, DO, PhD; Clinical Assistant Professor
David Vexler, MD; Clinical Assistant Professor
Eloy Villasuso, MD; Clinical Assistant Professor
David Vogt, MD; Clinical Associate Professor
Steven Wanek, MD; Clinical Assistant Professor
Robert Weaver, DPM; Clinical Instructor
Alvin Wee, MD; Clinical Assistant Professor
Eric Weiss, MD; Clinical Assistant Professor
David Westerdahl, MD; Clinical Assistant Professor
Steven Wexner, MD; Clinical Assistant Professor
Catherine Wilkins, MD; Clinical Assistant Professor
Ryan Williams, MD; Clinical Assistant Professor
Erika Woodson, MD; Clinical Assistant Professor
James Wu, MD PhD; Clinical Assistant Professor
Randall Yetman, MD; Clinical Assistant Professor
Jeh Yung, MD; Clinical Instructor
Salena Zanotti, MD; Clinical Assistant Professor
Andrea Zelisko, MD; Clinical Instructor
Aiwen Zhang, PhD; Clinical Assistant Professor
Tao Zhu, MD; Clinical Instructor
Yuriy Zhukov, MD; Clinical Assistant Professor
Stephen Zimberg, MD; Clinical Associate Professor

Urology
Andrew Altman, MD; Clinical Assistant Professor
Kevin Banks, MD; Clinical Assistant Professor
Michael Barkoukis, MD; Clinical Assistant Professor
Michael Berte, MD; Clinical Assistant Professor
Nabil Chehade, MD; Clinical Assistant Professor
Marc Cymes, MS; Clinical Instructor
Kim Fitzgerald, MD; Clinical Assistant Professor
Lawrence Gervasi, MD; Clinical Assistant Professor
Ehud Gnessin, MD; Clinical Assistant Professor
Julian Gordon, MD; Clinical Assistant Professor
Irina Jaeger, MD; Clinical Assistant Professor
Irina Jaejer, MD; Clinical Senior Instructor
Kiranpreet Khurana, MD; Clinical Assistant Professor
Gregory Kondray, MD; Clinical Assistant Professor
William Larchian, MD; Clinical Associate Professor
Frederic Levine, MD; Clinical Assistant Professor
Allan Love, MD; Clinical Assistant Professor
S. Mahoney III, MD; Clinical Assistant Professor
Mani Menon, MD; Clinical Professor
Maria Mir Maresma, MD; Clinical Instructor
Tim Sidor, MD; Clinical Assistant Professor
David Turk, MD; Clinical Assistant Professor
Lawrence Wolkoff, MD; Clinical Assistant Professor
Craig Zippe, MD; Clinical Professor
WEATHERHEAD SCHOOL OF MANAGEMENT

Peter B. Lewis Building
http://weatherhead.case.edu/
Phone: 216.368.2030

The Weatherhead School of Management (http://weatherhead.case.edu) cultivates creativity, innovation and purpose-driven leadership at every level: self, others, organizations and society. Weatherhead teaches design in management to prepare managers to create, innovate, lead and deliver new solutions for better business. We believe design thinking coupled with strengths-based management principles makes business one of the most powerful agents of positive change in the world.

Weatherhead is home to six academic departments comprising 67 full-time faculty members and 85 full-time staff members. It offers programs at the undergraduate, master’s and doctoral levels in the Peter B. Lewis Building and executive programming in the George S. Dively Building on the campus of Case Western Reserve University. Weatherhead is a business school that attracts interest from every corner of the globe while maintaining roots in the Cleveland community.

Mission Statement
Developing transformational ideas and outstanding leaders for the advancement of business and society.

Values
- Weatherhead believes that management is a noble profession committed to the advancement of human life.
- Weatherhead values its strong ethical foundation and strives to promote a culture rich in ideas and reflection.
- Weatherhead is committed to increasing individual creative and critical capacities, nurturing new and expansive patterns of thought.
- Weatherhead values research of enduring consequence and judges its significance by the impact it has on management thought, management action and public policy.
- Weatherhead values learning that is active and collaborative. Students, faculty and staff together engage important management problems with an innovative, knowledge-creating attitude.
- Weatherhead is responsive to the needs of its students.
- Weatherhead considers alumni important partners and strives to add value to their personal and professional lives.
- Weatherhead values partnerships with the business community and other organizations.
- Weatherhead values meaningful service to society and strives for outcomes that influence and positively change the way people and organizations conduct themselves.
- Weatherhead is a cohesive learning organization with an international outlook.
- Weatherhead values diversity, characterized by open dialogue and mutual respect among individuals with different specializations, backgrounds, cultures and perspectives.
- Weatherhead is results-oriented and judges contributions by actions taken and outcomes achieved.

Vision
Weatherhead is respected locally and globally for research of enduring consequence. The school is recognized for attracting and educating managers to design novel solutions to the most complex issues facing business and society. Weatherhead's learning environment is a hub of creative thinking, innovative teaching and trans-disciplinary research, filled with excitement and a strong sense of community.

Brief History
In 1952, Western Reserve University established the School of Business by combining the Cleveland College Division of Business Administration and the Graduate School Division of Business Administration, and from its founding until 1988, the activities of the School of Business were divided among a number of buildings both in downtown Cleveland and in University Circle. In 1967, the merger of Case Institute of Technology and Western Reserve University created Case Western Reserve University, and the Western Reserve University School of Business absorbed Case's Division of Organizational Sciences to become the School of Management in 1970. Just six years later, the School of Management launched its full-time MBA.

It was in 1980 that the School of Management was renamed in honor of Albert J. Weatherhead III, a Cleveland businessman and industrialist who represented the fourth generation of his family to carry on the Weatherhead name and values, including cultural and educational leadership. By 1999, the Weatherhead School of Management had developed a strong identity, growing out of its space in Enterprise Hall and requiring new construction. Funded by the philanthropist and entrepreneur whose name it bears, the Peter B. Lewis building, designed by renowned contemporary architect Frank Gehry and completed in 2002, was the answer. Located across the street from the George S. Dively Building, which houses Weatherhead Executive Education programs, the Lewis Building, featuring Gehry's unmistakable sculptural profile and gleaming stainless steel roof, both sets the school apart from its surroundings and, quite literally, reflects the prestigious neighborhood of the school. Gehry redefined the way a business school should look, just as Weatherhead redefines the way management education should take place.

Accreditation
The programs of the Weatherhead School of Management have been fully accredited by The Association to Advance Collegiate Schools of Business (AACSB) International since 1958.

Administration
Manoj Malhotra, PhD
(Ohio State University)
Dean, Weatherhead School of Management; Albert J. Weatherhead III Professor of Management; Professor, Operations

Deborah Bibb
Assistant Dean, Admissions

Debra Bruss
Associate Dean, Finance and Administration

Denise Douglas, PhD
(University of Minnesota)
Associate Dean, Executive Education
Undergraduate Programs

Anurag Gupta, PhD  
(New York University)  
Associate Dean, Global Initiatives; Chair and Professor, Banking and Finance

Jim Hurley  
Assistant Dean, Undergraduate and Integrated Programs

Susan Iler  
Assistant Dean, Marketing

Jennifer Johnson, MBA  
(Case Western Reserve University)  
Associate Dean, Undergraduate and Integrated Programs; Associate Professor, Design & Innovation

Leonardo Madureira, PhD  
(University of Pennsylvania)  
Associate Dean, Research; Deborah and David Daberko Fellow and Associate Professor, Banking and Finance

Simon Peck, PhD  
(University of Leeds)  
Associate Dean, MBA Programs; Associate Professor, Design & Innovation

Meenakshi Sharma  
Assistant Dean, Career & Student Affairs

Tiffany Welch  
Assistant Dean, Curriculum and Administration, Master of Accountancy

Department Chairs

Diana Bilimoria, PhD  
(University of Michigan)  
KeyBank Professor, Chair and Professor, Organizational Behavior

Robin Dubin, PhD  
(Johns Hopkins University)  
University Marshal, Chair and Professor, Economics

CNV Krishnan, PhD  
(University of Wisconsin-Madison)  
Chair and Professor, Banking and Finance; Faculty Director, MSM-Finance

Kalle Lyytinen, PhD  
(University of Jyväskylä)  
Iris S. Wolstein Professor of Management Design; Faculty Director, DM Program; Chair and Professor, Design & Innovation

Kamlesh Mathur, PhD  
(Case Western Reserve University)  
Chair and Professor, Operations

Mark Taylor, PhD, CPA  
(University of Arizona)  
Andrew D. Braden Professor of Accounting and Auditing; Chair and Professor, Accountancy

Bachelor of Science (BS) in Accounting

The accounting profession demands a high degree of technical training, similar to the professions of architecture, law, engineering and medicine, and a broad knowledge of the fundamentals of economics and business with a commitment to public well-being. Career opportunities in accounting include the public, corporate, government, nonprofit and healthcare sectors. The undergraduate program in accountancy is designed to prepare students for entrance into these careers and to provide a foundation for the examination to become a CPA or to achieve other professional certifications. Each state Board of Accountancy (https://www.nasba.org/stateboards) has its own eligibility requirements for taking the CPA exam. Students pursuing a BS in Accounting should consult the Board of Accountancy (https://www.nasba.org/stateboards) website for the state in which they plan to sit for the CPA examination in order to determine specific course requirements.

As part of the sequence of courses leading to the BS in Accounting offered through Weatherhead, the student takes required and elective courses in related fields of banking and finance, economics, marketing, organizational behavior and operations.

General Education Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>SAGES</td>
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<tr>
<td>First Seminar</td>
<td>4</td>
</tr>
<tr>
<td>Two University Seminars</td>
<td>6</td>
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<tr>
<td>Departmental Seminars - taken as MGMT 395, see Core Requirements</td>
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<tr>
<td>Senior Capstone ‡</td>
<td>3-6</td>
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<tr>
<td>Breadth Requirements</td>
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<tr>
<td>MATH 125 Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
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<tr>
<td>or MATH 121 Calculus for Science and Engineering I</td>
<td></td>
</tr>
<tr>
<td>MATH 126 Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 122 Calculus for Science and Engineering II</td>
<td></td>
</tr>
<tr>
<td>Two Natural Science Courses</td>
<td>6-8</td>
</tr>
<tr>
<td>Two Arts &amp; Humanities Courses</td>
<td>6-8</td>
</tr>
<tr>
<td>Two Social Science Courses</td>
<td>6</td>
</tr>
</tbody>
</table>

Degree Requirements

Students who desire a Secondary Major in Accounting should consult with a Weatherhead academic advisor.

Principles Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 102</td>
<td>Principles of Microeconomics</td>
<td>3</td>
</tr>
<tr>
<td>ECON 103</td>
<td>Principles of Macroeconomics</td>
<td>3</td>
</tr>
<tr>
<td>OPRE 207</td>
<td>Statistics for Business and Management Science I</td>
<td>3</td>
</tr>
</tbody>
</table>

Core Requirements

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BAFI 355</td>
<td>Corporate Finance</td>
<td>3</td>
</tr>
<tr>
<td>MGMT 201</td>
<td>Contemporary Business and Communication</td>
<td>3</td>
</tr>
<tr>
<td>MKMR 201</td>
<td>Marketing Management</td>
<td>3</td>
</tr>
<tr>
<td>OPRE 301</td>
<td>Operations Research and Supply</td>
<td>3</td>
</tr>
<tr>
<td>ORBH 250</td>
<td>Leading People (LEAD I)</td>
<td>3</td>
</tr>
<tr>
<td>MGMT 395</td>
<td>Advanced Seminar *</td>
<td>3</td>
</tr>
</tbody>
</table>

Major Requirements
Weatherhead students. Once admitted, students in the integrated study program are required to design a comprehensive study plan with their Weatherhead undergraduate adviser.

**Early Admission to the Integrated Study Program in Accountancy**

Each year, approximately 10 to 15 exceptionally well-qualified high school seniors who plan to pursue careers in accountancy will be offered Early Admission to the Integrated Study Program in Accountancy (https://weatherhead.case.edu/degrees/undergraduate/academics/ accounting/integrated-program) at Case Western Reserve University. Early admits receive a conditional commitment of admission to the Weatherhead School of Management Master of Accountancy (https://weatherhead.case.edu/degrees/masters/m-accountancy) program and a scholarship package covering a minimum of 50% of an academic year’s tuition cost to be honored when students formally enroll as a graduate student. Students are required to maintain a minimum undergraduate GPA of 3.2 overall and in accountancy courses. Those who achieve higher grade point averages will be eligible for greater scholarship amounts.

**Practicum Program**

The practicum program (http://students.case.edu/careers/students/jobs/practicums) is a planned, structured, supervised workplace experience at an approved “site” organization. The practicum is an experiential learning arrangement between the student, the employer, and the practicum adviser in conjunction with the University Career Center. Employers provide appropriate supervision and work-related learning while the practicum adviser guides and evaluates the student’s experience. The primary goal of this active learning experience is the intellectual, personal and professional growth of the student in an area related to the student’s academic goals. The practicum should provide the student with new skills, insights and experiences that are transferable to the academic setting.

Students apply to the University Career Center in the semester preceding the work assignment and may participate in up to two practicums. All practicums developed through the University Career Center must be taken for transcript notation, and students must have a faculty member serve as a practicum adviser. If a student elects to work in an internship/practicum without enrolling in the course for academic notation, he or she will not have the benefits of full-time student status. Additionally, he or she will not represent the practicum program in any official capacity.

**Sample Plan of Study: Bachelor of Science in Accounting**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall</td>
</tr>
<tr>
<td>Introduction to Financial Accounting (ACCT 101)</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Microeconomics (ECON 102)</td>
<td>3</td>
</tr>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I (MATH 125)</td>
<td>4</td>
</tr>
<tr>
<td>Arts &amp; Humanities</td>
<td>3</td>
</tr>
<tr>
<td>SAGES (University Seminar)</td>
<td>4</td>
</tr>
<tr>
<td>PHED (Physical Education)</td>
<td></td>
</tr>
<tr>
<td>Management Accounting (ACCT 102)</td>
<td>3</td>
</tr>
<tr>
<td>Excel Applications and Modeling (ACCT 207)</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Macroeconomics (ECON 103)</td>
<td>3</td>
</tr>
<tr>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II (MATH 126)</td>
<td>4</td>
</tr>
</tbody>
</table>

Undergraduate accounting students at Case Western Reserve have the unique opportunity to pursue both the Bachelor of Science (BS) in Accounting and the Master of Accountancy (MAcc) at the same time through the Integrated Study Program (https://weatherhead.case.edu/degrees/undergraduate/academics/accounting/integrated-program). The Integrated Study Program allows students to complete both degrees in four or five years, most commonly, four-and-a-half years or nine academic semesters. Each year, a select number of exceptionally well-qualified high school seniors who plan to pursue careers in accountancy are offered places in the Early Admission to the Integrated Study Program in Accountancy, although students may apply to the integrated program once they have begun their studies at Case Western Reserve. Because of the necessity for proper planning of coursework and programs, undergraduate students are strongly encouraged to apply for the MAcc in their junior year. All Weatherhead students must apply for and be admitted to the MAcc program, although certain requirements are waived, such as the Graduate Management Admission Test (GMAT), for Weatherhead students. Once admitted, students in the integrated study program are required to design a comprehensive study plan with their Weatherhead undergraduate adviser.

Students pursuing the BS in Accounting are advised to take the two introductory classes, ACCT 101 Introduction to Financial Accounting and ACCT 102 Management Accounting, and ACCT 207 Excel Applications and Modeling as early as possible. Students are advised to take ORBH 250 Leading People (LEAD I) in the second year.

Students enrolled in the BS in Accounting degree program may not use the P/NP option for Weatherhead courses. Twelve credit hours of accounting coursework taken at another accredited institution may be considered for transfer toward the BS in Accounting, although transfer credit for courses must be approved by the Accountancy Department. Each student is required to consult with an advisor in the Office of Undergraduate and Integrated Study Programs at Weatherhead.
For more information, contact Tiffany Welch (tiffany.welch@case.edu), assistant dean, undergraduate and integrated study programs, at 216.368.2058.

### Bachelor of Arts (BA) in Economics (College of Arts and Sciences)

The BA in Economics is a 120-credit-hour, structured program in which students learn to analyze problems of resource allocation and decision making, and to understand the influence of these factors on economies and societies.

Our highly regarded degree attracts some of the best students on campus. Students have the opportunity to assist Weatherhead faculty in their research activities and to participate in independent research projects.

#### General Degree Requirements

Students are required to complete the Arts and Sciences General Education Requirements (p. ).

Students who desire a Secondary Major in Economics should consult with a Weatherhead academic advisor.

#### Major Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 121</td>
<td>Calculus for Science and Engineering I</td>
<td>4</td>
</tr>
<tr>
<td>or MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>ECON 102</td>
<td>Principles of Microeconomics</td>
<td>3</td>
</tr>
<tr>
<td>ECON 103</td>
<td>Principles of Macroeconomics</td>
<td>3</td>
</tr>
<tr>
<td>ECON 307</td>
<td>Intermediate Macro Theory</td>
<td>3</td>
</tr>
<tr>
<td>ECON 308</td>
<td>Intermediate Micro Theory</td>
<td>3</td>
</tr>
<tr>
<td>or ECON 309</td>
<td>Intermediate Micro Theory: Calculus-Based</td>
<td>3</td>
</tr>
<tr>
<td>OPRE 207</td>
<td>Statistics for Business and Management Science I</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 243</td>
<td>Statistical Theory with Application I</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 312</td>
<td>Basic Statistics for Engineering and Science</td>
<td>3</td>
</tr>
<tr>
<td>ECON 326</td>
<td>Econometrics (Ideally, Econometrics should be taken by the junior year to enrich understanding of upper-level elective courses and to enable engagement in more sophisticated economic analysis.)</td>
<td>4</td>
</tr>
</tbody>
</table>

Elective courses (a minimum of five additional economics courses at the 200 or 300 level). ECON 398 Honors Research II does not count toward fulfilling this requirement.

Total Units 38

#### SAGES Senior Capstone Experience

The economics major does not require a capstone as part of the major. However, students need to complete a capstone as part of the SAGES requirement. The Economics Department offers the following courses for a capstone.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECON 398</td>
<td>Honors Research II</td>
</tr>
<tr>
<td>ECON 395</td>
<td>The Economy in the American Century</td>
</tr>
</tbody>
</table>
ECON 399 Individual Readings and Research (upon approval of Senior Capstone Coordinator) 3-6

For more information, contact Teresa Kabat (teresa.kabat@case.edu), department administrator, at 216.368.4110.

Bachelor of Science (BS) in Management

Graduates of the BS in Management degree program obtain a broad education within a scientific framework that enables them to bring an unusual degree of analytical capability to the problems of management and business. Each student is required to complete an approved major program of study from the options outlined below. In addition, each student must consult with an adviser in the Office of Undergraduate and Integrated Study Programs at Weatherhead.

General Education Requirements

SAGES
First Seminar 4
Two University Seminars 6
Departmental Seminars - taken as MGMT 395, see below* 3-6
Senior Capstone **

Breadth Requirements
MATH 125 Math and Calculus Applications for Life, Managerial, and Social Sci I 4
or MATH 121 Calculus for Science and Engineering I
MATH 126 Math and Calculus Applications for Life, Managerial, and Social Sci II 4
or MATH 122 Calculus for Science and Engineering II
Two Natural Science Courses 6-8
Two Arts & Humanities Courses 6-8
Two Social Sciences Courses 6

Management Degree Requirements

Principles Requirements
ECON 102 Principles of Microeconomics 3
ECON 103 Principles of Macroeconomics 3
ACCT 101 Introduction to Financial Accounting 3
ACCT 102 Management Accounting 3
OPRE 207 Statistics for Business and Management Science I 3

Core Requirements
MGMT 201 Contemporary Business and Communication 3
BAFI 355 Corporate Finance 3
ORBH 250 Leading People (LEAD I) 3
ORBH 251 Leading Organizations (LEAD II) 3
MIDS 301 Introduction to Information: A Systems and Design Approach 3
MKMR 201 Marketing Management 3
OPRE 301 Operations Research and Supply Chain Management 3
PLCY 399 Business Policy

MGMT 395 Advanced Seminar (*MGMT 395- one credit hour seminar; each student must complete three) 3

Major Requirements

Students must complete an 18-credit-hour major in Business Management, Finance, Marketing, or a Dean’s Approved Major. Students who desire a Secondary Major in one of these areas should consult with a Weatherhead academic advisor.

Business Management Major Requirements (18)

1. Complete three courses (9 cr) from within one of the following concentrations:

   Innovation and Entrepreneurship
   ECON 364 Economic Analysis of Business Strategies 3
   ECON 369 Economics of Technological Innovation and Entrepreneurship 3
   ENTP 301 Entrepreneurial Strategy (Required) 3
   ENTP 311 Entrepreneurship and Wealth Creation 3
   BLAW 331 Legal Environment of Management 3
   ORBH 380 Managing Negotiations 3
   MKMR 312 Selling and Sales Management 3

   NOTE: ENTP 301 is required for this Concentration. Students completing an Innovation and Entrepreneurship Concentration may not complete an Entrepreneurship minor.

   International Business
   ECON 375 Economics of Developing Countries 3
   BAFI/ECON 372 International Finance 3
   ECON 373 International Trade 3
   MGMT 315 International Management Institute (Required) 3
   ORBH 391 Leadership in Diversity and Inclusion: Towards a Globally Inclusive Workplace 3

   NOTE: MGMT 315 is required for this Concentration. If a student wishes to substitute a course from another study abroad experience, he/she must receive prior approval from an academic advisor.

   Organizational Leadership
   ORBH 360 Independent Study 1-6
   ORBH 391 Leadership in Diversity and Inclusion: Towards a Globally Inclusive Workplace 3
   ORBH 303 Leading Teams through Interpersonal Relationships 3
   ORBH 380 Managing Negotiations 3
   ORBH 370 Women and Men as Colleagues in Organizations 3

   NOTE: Students completing an Organizational Leadership Concentration may not complete a Leadership Minor.

   Supply Chain Management
OPRE 332  Computer Simulation  3
OPMT 377  Enterprise Resource Planning in the Supply Chain  3
OPMT 422  Lean Operations  3
OPMT 350  Project Management  3
OPMT 475  Supply Chain Logistics  3

2. Complete one of:
   BAFI 361  Applied Financial Analytics  3
   ECON 326  Econometrics  4
   MKMR 310  Marketing Analytics  3

3. Complete two additional Weatherhead electives

Finance Major Requirements
BAFI 341  Money and Banking  3
or ECON 341  Money and Banking  3
BAFI 356  Investments  3
BAFI 357  Financial Modeling, Analysis and Decision Making  3
BAFI 358  Intermediate Corporate Finance  3
BAFI 359  Cases in Finance  3
BAFI 361  Applied Financial Analytics  3

Marketing Major Requirements
MKMR 304  Brand Management  3
MKMR 308  Measuring Marketing Performance  3
MKMR 310  Marketing Analytics  3
MKMR 311  Customer Relationship Management  3
MKMR 312  Selling and Sales Management  3
MKMR 348  Strategic Internet Marketing  3

A student may consult with an advisor to develop a proposal for individualized study in an area of interest, subject to approval by the Weatherhead Undergraduate Executive Committee.

Dean's Approved Major Requirements
1. Complete five courses (15 cr) around a common interest, selected in conjunction with a major advisor.  15
2. Complete one of:
   BAFI 361  Applied Financial Analytics  3
   ECON 326  Econometrics  3
   MKMR 310  Marketing Analytics  3

For more information, contact Jim Hurley, assistant dean of undergraduate and integrated study programs at 216.368.3856.

Additional Requirement
Electives  16-23

Total Credit Hours for Degree: 122

Students pursuing a BS in Management are advised to take the ORBH 250 Leading People (LEAD I) and ORBH 251 Leading Organizations (LEAD II) sequence in the second year. Management degree students may not use the P/NP option for any Weatherhead courses.

Sample Plan of Study: BS in Management

First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
</table>
Math and Calculus Applications for Life, Managerial, and Social Sci I (MATH 125) | 4 |
Introduction to Financial Accounting (ACCT 101) | 3 |
Principles of Microeconomics (ECON 102) | 3 |
Arts/Humanities | 3 |
SAGES (University Seminar) | 4 |
PHED | |
Math and Calculus Applications for Life, Managerial, and Social Sci II (MATH 126) | 4 |
Management Accounting (ACCT 102) | 3 |
Principles of Macroeconomics (ECON 103) | 3 |
Contemporary Business and Communication (MGMT 201) | 3 |
SAGES (University Seminar) | 3 |
PHED | |
Year Total: | 17 | 16 |

Second Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
</table>
Leading People (LEAD I) (ORBH 250) | 3 |
Statistics for Business and Management Science I (OPRE 207) | 3 |
Corporate Finance (BAFI 355) | 3 |
Natural Sciences | 3 |
SAGES (University Seminar) | 3 |
Leading Organizations (LEAD II) (ORBH 251) | 3 |
Marketing Management (MKMR 201) | 3 |
Natural Sciences | 3 |
Social Sciences | 3 |
Arts/Humanities | 3 |
Year Total: | 15 | 15 |

Third Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
</table>
Elective | 3 |
Weatherhead Major | 3 |
Weatherhead Major | 3 |
Social Sciences | 3 |
Introduction to Information: A Systems and Design Approach (MIDS 301) | 3 |
Operations Research and Supply Chain Management (OPRE 301) | 3 |
Advanced Seminar (MGMT 395) | 1 |
Weatherhead Major | 3 |
Weatherhead Major | 3 |
Elective | 3 |
Year Total: | 15 | 16 |

Students must complete one university-approved SAGES Senior Capstone. It is not required that students complete a Weatherhead-specific capstone. However, the vast majority of students take MGMT 398 Action Learning. Highly motivated students with a keen interest in a particular business topic may complete an individual research project via MGMT 397, subject to approval by the Weatherhead Undergraduate Executive Committee.
Fourth Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action Learning (MGMT 398)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>MGMT 395</td>
<td>1</td>
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<tr>
<td>Weatherhead Major</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Business Policy (PLCY 399)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MGMT 395</td>
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<tr>
<td>Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 122

Minors

Minor in Accounting

| ACCT 101 | Introduction to Financial Accounting | 3 |
| ACCT 102 | Management Accounting | 3 |
| ACCT 207 | Excel Applications and Modeling | 3 |
| ACCT 300 | Corporate Reporting I | 3 |
| One additional 300-level accounting courses | | 3 |
| Total Units | 15 |

Minor in Banking and Finance

Required:

| ACCT 102 | Management Accounting | 3 |
| BAFI 355 | Corporate Finance | |
| BAFI 356 | Investments | |
| BAFI 357 | Financial Modeling, Analysis and Decision Making | |
| BAFI 358 | Intermediate Corporate Finance | |
| BAFI 359 | Cases in Finance | |
| BAFI 361 | Applied Financial Analytics | |
| Total Units | 15 |

Minor in Entrepreneurial Studies

Required:

| ACCT 102 | Management Accounting | 3 |
| MKMR 201 | Marketing Management | 3 |
| ENTP 301 | Entrepreneurial Strategy | 3 |
| ENTP 310 | Entrepreneurial Finance - Undergraduate | 3 |
| ENTP 311 | Entrepreneurship and Wealth Creation | 3 |
| Total Units | 15 |

Minor in Economics

| ECON 102 | Principles of Microeconomics | 3 |
| ECON 103 | Principles of Macroeconomics | 3 |
| Total Units | 15 |

Minor in Leadership

Required:

| ORBH 250 | Leading People (LEAD I) | 3 |
| ORBH 303 | Leading Teams through Interpersonal Relationships | |
| ORBH 370 | Women and Men as Colleagues in Organizations | |
| ORBH 380 | Managing Negotiations | |
| ORBH 396 | Professional Development for Engineers | |
| ORBH 251 | Leading Organizations (LEAD II) | 3 |
| Total Units | 9 |

Minor in Business Management

Note: Business Management minor is not open to WSOM majors.

Required:

| ECON 102 | Principles of Microeconomics | 3 |
| ECON 103 | Principles of Macroeconomics | 3 |
| ACCT 203 | Survey of Accounting (Recommended) | 3 |
| ACCT 101 | Introduction to Financial Accounting | |
| Total Units | 9 |
Weatherhead undergraduate students. Once admitted, students in an waived, such as the Graduate Management Admission Test (GMAT), for be admitted to the MAcc program, although certain requirements are in the MAcc in their junior year. Weatherhead students must apply for and programs, undergraduate students are strongly encouraged to apply for attractive to top accounting firms.

The integrated program saves qualified students both hours of study at the university level in order to qualify to sit for the CPA examination. The integrated program permits students to work towards the completion of the Master of Accountancy during their undergraduate studies thereby enabling completion of both degrees in as little as four years. If after completion of the bachelor’s degree an additional semester is needed to complete the MAcc or if a student chooses to complete a majority of the MAcc in a fifth year, the student would then enroll solely as a graduate student in the Weatherhead School of Management to complete the master’s degree. Depending on the student’s academic record and total credit hours completed, they may choose to double count up to six credit hours (two courses) towards the BS and the MAcc.

These programs are strongly recommended for those individuals planning to obtain professional certification as a certified public accountant (CPA). CPA candidates must have completed 150 semester hours of study at the university level in order to qualify to sit for the CPA examination. The integrated program saves qualified students both time and money while equipping students with the skills and knowledge attractive to top accounting firms.

Because of the necessity for proper planning of coursework and programs, undergraduate students are strongly encouraged to apply for the MAcc in their junior year. Weatherhead students must apply for and be admitted to the MAcc program, although certain requirements are waived, such as the Graduate Management Admission Test (GMAT), for Weatherhead undergraduate students. Once admitted, students in an integrated study program are required to design a comprehensive study plan with both their Weatherhead undergraduate adviser and the faculty director of the MAcc program.

For more information, contact Tiffany Welch (tiffany.welch@case.edu), assistant dean of undergraduate and integrated study programs, at 216.368.2058 or Ashley Lu (ashley.lu@case.edu), program manager, MAcc, at 216.368.5376.

BA/BS degree and MSM-Finance Integrated Program (https://weatherhead.case.edu/degrees/undergraduate/academics/finance/integrated-program) As a student in the BA/BS and MSM-Finance Integrated Study (https://weatherhead.case.edu/degrees/undergraduate/academics/finance/integrated-program) program, you can obtain a BA/BS degree and an MSM-Finance degree in as little as four years.

For more information, contact Jim Hurley (james.hurley@case.edu), Assistant Dean of Undergraduate and Integrated Study Programs, at 216.368.3856, or Marybeth Keeler (mxk761@case.edu), Program Manager, MSM-Finance, at 216.368.3688.

### Master of Business Administration (MBA)

#### Full-Time MBA

The full-time MBA program is a four-semester, 60-credit program that provides students with the foundational principles necessary to be a leader in management while opening opportunities for students to pursue their passions and customize their experience. In partnership with faculty and staff, students create a personalized learning plan, choosing electives that comprise almost half of the program of study to complement core curriculum for an integrated, yet focused, MBA.

Distinctive courses in Weatherhead’s MBA program help students assess their strengths and develop a learning plan to improve their weaker areas. Upon enrolling in the MBA, students take Leading People and Organizations, which facilitates the discovery of individual management strengths and weaknesses through a series of self-assessments, experiential activities, and case studies on team and group dynamics. In addition to mastering the core areas of accounting, finance, marketing and supply chain management, strategy, statistics and decision modeling, and economics, the core curriculum also requires students to take two courses in design and sustainability. In the first semester, MBA students learn the principles of sustainability, which creates a foundational platform for building sustainable value and turning the social and global issues of the day into business opportunities. In the second semester, students are introduced to design, which gives the students a method to bring together changing technologies, capabilities, relationships, activities, and materials to shape an organization’s plans and strategies.

The second year of the program is almost entirely dedicated to the students’ fully customized schedule of electives. Additionally, students take the AMES Business Models I and II, the only two core courses in the second year. These two courses empower teams of students to address the challenges of developing a business model for a company or organization. In three distinct projects across two semesters, students help develop the core business model for a start-up company or newly commercialized technology, for an existing product line within mature companies (small, medium or large enterprise), and for a company located outside of the United States. Students work closely with business

<table>
<thead>
<tr>
<th>Total Units</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Minor in Marketing</th>
</tr>
</thead>
</table>

**Required:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKMR 201</td>
<td>Marketing Management</td>
<td>3</td>
</tr>
<tr>
<td>MKMR 304</td>
<td>Brand Management</td>
<td></td>
</tr>
<tr>
<td>MKMR 308</td>
<td>Measuring Marketing Performance</td>
<td></td>
</tr>
<tr>
<td>MKMR 310</td>
<td>Marketing Analytics</td>
<td></td>
</tr>
<tr>
<td>MKMR 311</td>
<td>Customer Relationship Management</td>
<td></td>
</tr>
<tr>
<td>MKMR 312</td>
<td>Selling and Sales Management</td>
<td></td>
</tr>
<tr>
<td>MKMR 348</td>
<td>Strategic Internet Marketing</td>
<td></td>
</tr>
<tr>
<td>MKMR 355</td>
<td>Communications Management in a Digital Marketplace</td>
<td></td>
</tr>
<tr>
<td>ANTH 102</td>
<td>Being Human: An Introduction to Social and Cultural Anthropology</td>
<td></td>
</tr>
<tr>
<td>ECON 328</td>
<td>Designing Experiments for Social Science, Policy, and Management</td>
<td></td>
</tr>
<tr>
<td>ENTP 301</td>
<td>Entrepreneurial Strategy</td>
<td></td>
</tr>
<tr>
<td>PSCL 315</td>
<td>Social Psychology</td>
<td></td>
</tr>
</tbody>
</table>

**Total Units: 15**

For more information, contact Jim Hurley (james.hurley@case.edu), assistant dean of undergraduate and integrated study programs, at 216.368.3856.

### Integrated Study Program in Accountancy

The Integrated BS in Accounting/Master of Accountancy (MAcc) (https://weatherhead.case.edu/degrees/undergraduate/academics/accounting/integrated-program) program permits students to work towards the completion of the Master of Accountancy during their undergraduate studies thereby enabling completion of both degrees in as little as four years. If after completion of the bachelor’s degree an additional semester is needed to complete the MAcc or if a student chooses to complete a majority of the MAcc in a fifth year, the student would then enroll solely as a graduate student in the Weatherhead School of Management to complete the master’s degree. Depending on the student’s academic record and total credit hours completed, they may choose to double count up to six credit hours (two courses) towards the BS and the MAcc.

These programs are strongly recommended for those individuals planning to obtain professional certification as a certified public accountant (CPA). CPA candidates must have completed 150 semester hours of study at the university level in order to qualify to sit for the CPA examination. The integrated program saves qualified students both time and money while equipping students with the skills and knowledge attractive to top accounting firms.

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### Master of Business Administration (MBA)

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The full-time MBA program is a four-semester, 60-credit program that provides students with the foundational principles necessary to be a leader in management while opening opportunities for students to pursue their passions and customize their experience. In partnership with faculty and staff, students create a personalized learning plan, choosing electives that comprise almost half of the program of study to complement core curriculum for an integrated, yet focused, MBA.

Distinctive courses in Weatherhead’s MBA program help students assess their strengths and develop a learning plan to improve their weaker areas. Upon enrolling in the MBA, students take Leading People and Organizations, which facilitates the discovery of individual management strengths and weaknesses through a series of self-assessments, experiential activities, and case studies on team and group dynamics. In addition to mastering the core areas of accounting, finance, marketing and supply chain management, strategy, statistics and decision modeling, and economics, the core curriculum also requires students to take two courses in design and sustainability. In the first semester, MBA students learn the principles of sustainability, which creates a foundational platform for building sustainable value and turning the social and global issues of the day into business opportunities. In the second semester, students are introduced to design, which gives the students a method to bring together changing technologies, capabilities, relationships, activities, and materials to shape an organization’s plans and strategies.

The second year of the program is almost entirely dedicated to the students’ fully customized schedule of electives. Additionally, students take the AMES Business Models I and II, the only two core courses in the second year. These two courses empower teams of students to address the challenges of developing a business model for a company or organization. In three distinct projects across two semesters, students help develop the core business model for a start-up company or newly commercialized technology, for an existing product line within mature companies (small, medium or large enterprise), and for a company located outside of the United States. Students work closely with business

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leaders all over the world throughout the course to develop solid business models and clear, creative, and ambitious final presentations on their projects.

**Independent Study**

MBA students are limited to six credit hours of elective credit as independent study. Any student wishing to take more than six credit hours of independent study must petition the faculty director of the full-time MBA.

Other courses at the university may be eligible for MBA elective credit. Contact the faculty director of the full-time MBA for additional information.

**Curriculum**

All of the core courses in the following tables are required.

### First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial and Managerial Accountancy (ACCT 401)</td>
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### Second Year

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</table>

Total Units in Sequence: 60

**Electives**

The program provides space for taking eight elective courses.

For additional information about this program, contact Deborah Bibb (debora.bibb@case.edu), assistant dean of admissions, 216.368.6702.

---

**Part-Time MBA**

The part-time MBA is a 48-credit-hour, cohort-based program that combines a core of fundamental business classes with elective options to create an integrated experience focused on honing general management skills. Students develop a personalized learning plan through the MBAP 401 Leadership Assessment and Development (LEAD) course.

Core classes meet one evening a week. Summer semesters may include more intensive formats.

The first summer semester begins with the intensive offering of LEAD and moves through the rest of the core offerings within the first two years of the program. The majority of the third year is devoted to electives.

**Curriculum**

### First Year

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<tr>
<th>Units</th>
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<tbody>
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<td>Economics (MBAC 512)</td>
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<td>Strategic Issues and Applications (MBAC 508)</td>
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<td>Managerial Marketing (MBAP 407)</td>
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<td>Operations Management (MBAP 408)</td>
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<td>Strategic Issues and Applications (MBAP 410)</td>
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### Third Year

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<td>Identifying Design Opportunities (MBAP 411)</td>
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Total Units in Sequence: 48
Open Electives
Students in the part-time MBA program have the opportunity to choose five electives. Students determine their own focus areas and, with the help of our Career Management Office, learn how to best position themselves for post-MBA career advancement.

Traditional Students
Part-time students are those who entered the part-time MBA program in fall semester 2009 or prior, transferred in during summer semester 2010 or prior, or transitioned from non-degree to degree-seeking status prior to fall semester 2010. Students must complete 48 credit hours, consisting of 10 core required courses and 6 electives. The 48 hours must be completed within six years of starting the program.

For additional information about this program, contact Deborah Bibb (deborah.bibb@case.edu), assistant dean of admissions, 216.368.6702.

Executive MBA (EMBA)
The Executive MBA (EMBA) and the Cleveland Clinic-Weatherhead Executive MBA is tailored to those poised to move into a more prominent leadership role. Weatherhead’s renowned Organizational Behavior Department structured the EMBA around an exploration of the four levels of leadership, amplifying students’ ability to effect change at the personal, team, organization and societal levels. The program is based around periodic residencies in the company of intimate cohort groups.

Curriculum
The 48-credit-hour program takes place over 16 brief residencies. The curriculum is delivered over five semesters or 21 months. Both fall and spring semesters are comprised of four three-day residencies. The summer semester is delivered abroad through the EMBA 475 International Tour. Although individual study habits vary, students should anticipate devoting a minimum of 20 hours per week to study outside of classes.

The Weatherhead EMBA is a lock-step cohort program. Participants self-select learning teams which represent essential study partnerships over the course of the program as well as invaluable resources for networking and organizational support. Learning teams meet weekly outside of the classroom, either face-to-face or remotely, to achieve course objectives and enhance the learning experience. In addition, faculty often host optional study and review sessions, which are also recorded for virtual access.

First Year

<table>
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<tr>
<th>Units</th>
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<tbody>
<tr>
<td>Leading Change: Self (EMBA 441)</td>
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<tr>
<td>Accounting for Business Executives (EMBA 436)</td>
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<tr>
<td>Business Statistics and Quantitative Analysis (EMBA 438A)</td>
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<tr>
<td>Managerial Marketing (EMBA 450)</td>
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<tr>
<td>Expanding Boundaries (EMBA 445)</td>
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Second Year

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<td>Managing Risk and Real Options (EMBA 446)</td>
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<td>Legal Environment (EMBA 464)</td>
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<td>Leading Change: Society (EMBA 479)</td>
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<td>Leading Design in Organizations (EMBA 478B)</td>
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Total Units in Sequence: 48

* Year totals have been rounded up to 11.3, but the correct units are 11.25.

Cleveland Clinic-Weatherhead Executive MBA
The Cleveland Clinic-Weatherhead Executive MBA at Case Western Reserve University combines Weatherhead’s breakthrough business concepts of leadership in management with Cleveland Clinic’s innovation in health care to make this EMBA the premier option for experienced professionals in the health care profession. Participants in the Cleveland Clinic-Weatherhead EMBA join students in the traditional EMBA track to provide cross-pollination of ideas from a multitude of industries and experiences. Several healthcare-specific curriculum differences are noted in the plan of study below.

Curriculum

First Year

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<th>Units</th>
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<th>Summer</th>
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<tr>
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<td>Leading Change: Teams (EMBA 473)</td>
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<td>Expanding Boundaries (EMBA 445)</td>
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<td>Business Statistics and Quantitative Analysis (EMBA 438B)</td>
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<tr>
<td>Corporate Finance (EMBA 439)</td>
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</table>
Undergraduate accounting students at Case Western Reserve have the unique opportunity to pursue both the Bachelor of Science (BS) in Accounting and the MAcc through the Integrated Study (p. 968) program. The Integrated Study program allows students to complete both degrees in four or five years, most commonly, four-and-a-half years or nine academic semesters. Each year, a select number of exceptionally well-qualified high school seniors who plan to pursue careers in accountancy are offered places in the Early Admission to the Integrated Studies Program in Accountancy (p. 962), although students may apply to the integrated program once they have begun their studies at Case Western Reserve. Because of the necessity for proper planning of coursework and programs, undergraduate students are strongly encouraged to apply for the MAcc in their junior year. All Weatherhead students must apply for and be admitted to the MAcc program, although certain requirements are waived.

### Master's Programs

#### Master of Accountancy (MAcc)

The MAcc program at Weatherhead is designed for individuals who seek to obtain an advanced degree that builds upon the skills and knowledge acquired in an undergraduate degree in accountancy. The program is fully accredited and provides professional education by very highly qualified faculty members. In an increasingly competitive business environment, the MAcc program provides students with an important foundation for long-term success and sets graduates apart from their colleagues.

#### Undergraduate Opportunities

For more information, contact Michelle Wilson (michelle.j.wilson@case.edu), program manager of the EMBA, 216.368.6411.

### Prerequisite Courses

Because the program builds upon skills and knowledge developed in an undergraduate accountancy program, all admitted candidates must complete certain prerequisite courses. It is **not** required that students have all the prerequisite courses completed before beginning the MAcc program, but it is recommended that students have completed financial accounting and managerial accounting (Principles I and II) before beginning the program.

- **Prerequisite courses may be taken at any accredited four-year educational institution, although once students are admitted to the MAcc program department approval should be obtained in advance of enrolling in any prerequisite courses not taken at Case Western Reserve.**
- **Students may earn a grade of C or better in all prerequisite coursework.**

#### Curriculum

The 30-credit-hour MAcc program offers the flexibility of beginning in the fall or spring semester. Upon completion of the program,
graduates should have satisfied all accounting educational requirements for the CPA examination in the state of Ohio.

ACCT 404 Advanced Financial Reporting 3
ACCT 405 Advanced Federal Taxes 3
ACCT 406 Auditor's Role in AIS Accounting 3
ACCT 414 Corporate Reporting and Analysis 3
ACCT 431 Tax Practice: Analysis, Planning and Communications 3
ACCT 444 Advanced Auditing Theory and Practice 3
ACCT 495A Advanced Accounting Seminar (Audit) 1
ACCT 495T Advanced Accounting Seminar (Tax) 1
ACCT 520 Advanced Accounting Theory 3
ACCT 540 Corporate Governance and Contemporary Accounting Policy 3

Accountancy Concentration(s)
Students must complete at least one concentration in either Financial Reporting and Attestation Services or U.S. Taxation by completing the related series of three one-credit-hour ACCT 495: Advanced Accounting Seminars. The U.S. Taxation related seminars are offered in the fall and the Financial Reporting and Attestation Services related seminars are offered in the spring.

Supporting Elective
If students choose not to complete a second concentration, MAcc students may select one elective (three credit hours) in an area that complements a professional accountancy career. A list of approved graduate supporting electives will be provided each semester.

For more information about the MAcc, contact Tiffany Welch (tiffany.welch@case.edu), assistant dean, undergraduate and integrated study programs, at 216.368.2058 or Ashley Lu (ashley.lu@case.edu), program manager, MAcc, at 216.368.5376.

Master of Science in Management-Business Analytics (MSM-Business Analytics)
The Master of Science in Management-Business Analytics (MSM-Business Analytics) degree is an 11-month, 33-credit-hour, full-time program for students interested in learning advanced data analytics skills for application in general business areas, focusing specifically on both marketing and operations. The program prepares students to analyze big data for smart insights for executive decision making. The program includes three interlocking modules:

- business core (12 credit hours),
- analytics core (9 credit hours)
- applied business analytics (12 credit hours)

The Business Core provides students with a holistic understanding of the underlying business context necessary for succeeding in any industry. The Analytics Core equips students with the general data handling, data presentation and analysis skills, and the courses in Applied Business Analytics build off of these general skills to improve the students' ability to make decisions in the two focus application areas: marketing and operations.

The three overlapping areas emphasize our program's goals:

- building applied analytical skills
- for intelligent business decision making
- using a wide range of tools appropriate for today's business data.

The program is delivered through a range of open source and commercial statistical software (e.g., R, Python, SPSS, SAS), preparing students with the necessary user expertise to excel in analyst positions across industries.

Prerequisites
Students are required to have taken two calculus courses at the college level and one course in linear algebra. A course in statistics is strongly preferred.

Curriculum

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<tr>
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<td>Data Mining &amp; Visualization (MSBA 434)</td>
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<td>Marketing Models &amp; Digital Analytics (MSBA 435)</td>
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Total Units in Sequence: 33

For more information about this program, visit the website or contact Meredith Richardson (meredith.richardson@case.edu), admissions manager, at 216.368.7586.

Master of Engineering and Management (MEM)
The Master of Engineering and Management (MEM) degree is offered through an innovative collaboration between the Case School of Engineering and the Weatherhead School of Management. The one-year, 14-course program of study builds on the technical and analytical skills gained through an undergraduate engineering degree and provides a real-world framework for applying them along with master's level business management tools. Individualized coaching emphasizes self-assessment
and emotional intelligence. Interdisciplinary team projects enhance the people skills needed as a business leader today. The MEM program positions students to become more productive faster and in the process, accelerate their careers.

Additional information regarding the MEM program (p. 8) is available in the Case School of Engineering section of the Bulletin.

**Master of Science in Management-Finance (MSM-Finance)**

The Master of Science in Management-Finance (MSM-Finance) degree is a rigorous program designed to equip students to meet the needs of financial sector companies in today's intense and competitive business climate. Upon completion of the program, students will be prepared to make immediate contributions to careers in corporate finance, investment banking, equity research, investment management, risk management and corporate consulting, or to pursue higher studies.

The program’s 30 credit hours can be completed in as little as two semesters, or students can stay longer to work toward an additional nine-credit-hour departmental certification in a specialization track—corporate finance, risk management or financial big data—by taking appropriate additional electives.

**Curriculum**

The 30-credit-hour MSM-Finance program is a two-semester, full-time curriculum.

The curriculum is comprised of the following components:

**Core Courses**

The core courses provide students with the tools and techniques that build a strong foundation in finance.

Before the first fall semester begins, all entering MSM-Finance students have to take MSFI 401, Financial Orientation which is the mandatory preparatory/refresher course.

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<td>MSFI 421</td>
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<td>MSFI 429</td>
<td>Investment Management</td>
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<td>MSFI 430</td>
<td>Derivatives and Risk Management</td>
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<td>MSFI 435</td>
<td>Empirical Finance</td>
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<td>MSFI 436A</td>
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<tr>
<td>MSFI 436B</td>
<td>Individual, Team and Career Development</td>
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**Total Units** 18

**Electives**

Elective courses develop expertise in a particular track: corporate finance, risk management, or financial big data. Enrollment in elective courses may be contingent upon appropriate performance in the program.

**Corporate Finance Track**

<table>
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<tr>
<td>MSFI 440</td>
<td>Financial Decisions, Contracting &amp; Value</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSFI 444</td>
<td>Entrepreneurial Finance</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 450</td>
<td>Mergers and Acquisitions</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 480</td>
<td>Global Banking &amp; Capital Markets</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 490</td>
<td>Projects in Corporate Finance</td>
<td>3</td>
</tr>
</tbody>
</table>

**Risk Management Track**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSFI 431</td>
<td>Fixed Income Markets and Their Derivatives</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 432</td>
<td>Corporate Risk Management</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 433</td>
<td>Quantitative Risk Modeling</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 434</td>
<td>Financial Analytics and Banking</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 491</td>
<td>Projects in Risk Management</td>
<td>3</td>
</tr>
</tbody>
</table>

**Financial Big Data Track**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSFI 431</td>
<td>Fixed Income Markets and Their Derivatives</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 433</td>
<td>Quantitative Risk Modeling</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 460</td>
<td>Investment Strategies</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 470</td>
<td>Financial Models Using Big Data</td>
<td>3</td>
</tr>
<tr>
<td>MSFI 471</td>
<td>Applications in Financial Big Data</td>
<td>3</td>
</tr>
<tr>
<td>BAFI 492</td>
<td>Scientific Python Programming with</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Applications</td>
<td></td>
</tr>
</tbody>
</table>

Other appropriate electives, as approved by the program faculty director.

Departmental certification is available upon successful completion of 39 credit hours in a specific track.

For more information see the website (https://weatherhead.case.edu/degrees/masters/ms-management/finance) or contact Marybeth Keeler (mxk761@case.edu), program manager, at 216.368.3688; or Ted Evans (tx8@case.edu), director of admissions, at 216.368.2069.

**Finance in China**

The Weatherhead School of Management at Case Western Reserve University and the School of Economics and Management at Tongji University (SEM-Tongji) have partnered to offer the Master of Science in Management-Finance (MSM-Finance) in China program. This is the first master's degree in finance offered by a world-class U.S. university in mainland China. This innovative program, taught in Shanghai and Cleveland, provides students with both broad general management skills and depth of knowledge in finance. Graduates come away with a global way of thinking and the latest insights on the financial markets and instruments.

Students enrolled in this program take 30 credit hours of Weatherhead MSM-Finance courses through two semesters of part-time study on the Tongji University campus in Shanghai, plus a one month-long residency in the U.S., which includes classes on the Case Western Reserve University campus in Cleveland, Ohio, as well as a residency in New York City to interact with financial institutions on Wall Street.

Upon graduation from the program, students will obtain the MSM-Finance degree from Weatherhead.

**Program Features**

- Obtain the first MSM-Finance degree offered from a highly ranked U.S. university in mainland China
- Gain cutting-edge knowledge and skills in global finance
• Take advantage of the opportunity to prepare for CFA, FRM and other certifications
• Specialize in corporate finance, risk management and capital markets
• Network with financial sector players in the U.S.; intern in Shanghai’s Lujiazui/Pudong international finance and trade area

To learn more, contact Yuan Wu (yuan.wu@case.edu), project manager, at 216.368.2077.

Master of Science in Management-Healthcare (MSM-Healthcare)
The Master of Science in Management-Healthcare (MSM-Healthcare) at The Global Center for Health Innovation program prepares healthcare professionals and service providers to design and manage systems that optimize behaviors and processes for positive change and sustainable value.

Outcomes
Upon completion of the MSM-Healthcare program, students will:
• Gain an understanding of finance, accounting and business strategy
• Gain exposure to a wide range of healthcare settings including public health organizations
• Speak and understand the language of business
• Acquire a network of regional and national contacts in the healthcare sector

Curriculum
The MSM-Healthcare is a 30-credit-hour program that is completed in six semesters with one summer semester completely dedicated to an independent project.

First Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Economics and Strategy (HSMC 421)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounting for Healthcare (ACCT 401H)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Finance (HSMC 420) or Health Finance (BAFI 420)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Decision Making &amp; Analytics (HSMC 457)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identifying Design Opportunities (MBAP 411)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>6</td>
<td>6</td>
<td>3</td>
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</tbody>
</table>

Second Year

<table>
<thead>
<tr>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean Services Operations (HSMC 412)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managerial Marketing (HSMC 407)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dialogues in Health Care Management (HSMC 425)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managing People and Organizations (HSMC 404)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>12</td>
<td>12</td>
<td>6</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 30

The MSM-Healthcare program may also be completed full-time in one year. Contact a program manager for more information about this option.

Accelerated Curriculum Plan

<table>
<thead>
<tr>
<th>Plan of Study</th>
<th>Units</th>
<th>Fall</th>
<th>Spring</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Economics and Strategy (HSMC 421)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lean Services Operations (HSMC 412)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounting for Healthcare (ACCT 401H)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managerial Marketing (HSMC 407)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Finance (HSMC 420) or Health Finance (BAFI 420)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Decision Making &amp; Analytics (HSMC 457)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dialogues in Health Care Management (HSMC 425)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managing People and Organizations (HSMC 404)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identifying Design Opportunities (MBAP 411)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action Learning Project (MGMT 497)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Total:</td>
<td>12</td>
<td>12</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Total Units in Sequence: 30

For additional information about this program, contact Deborah Bibb (deborah.bibb@case.edu), assistant dean of admissions, at 216.368.6702.

Master of Science in Management in Operations Research and Supply Chain Management (MSM-ORSC)
The MSM-ORSC degree is designed for individuals with quantitative training who seek to obtain a position in operations management or a management position in manufacturing, healthcare, service or consulting firms that are part of sophisticated national or global supply chains. The MSM-ORSC curriculum provides students with the fundamentals of business as well as depth and focus in the principles and concepts of operations and supply chain management. This unique program produces highly knowledgeable professionals well prepared to make organizations more efficient and competitive.

The MSM-ORSC degree attracts individuals with a quantitative undergraduate degree who have an interest in gaining expertise in the field of operations research and supply chain management. Typical undergraduate majors include:
• Engineering
• Statistics
• Computer science
• Economics
• Mathematics
• Business

Students beginning this program must have a working knowledge of undergraduate calculus, including differentiation and integration, and one semester of undergraduate linear algebra. Work experience is beneficial but not required for admission; many students pursue the MSM-ORSC immediately following the completion of their undergraduate degree.

Outcomes
Upon completion of the MSM-ORSC program, students will:
• Be equipped with analytical and supply chain skills to become an agent of positive change at their organization within the first few years of work
• Speak and understand the language of business
• Have a working knowledge of all functional areas of an organization and the ability to communicate effectively with colleagues in these areas
• Have a network of regional, national and international business contacts

Curriculum
The 39-credit-hour MSM-ORSC is a three-semester, full-time program beginning in the fall semester of each year. The curriculum comprises the following three components:

Business Core (9 credit hours)
The Business Core introduces students to business fundamentals and includes a professional development course, a unique feature of the Weatherhead MSM-ORSC not found in most competitors’ programs.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSOR 407</td>
<td>Managerial Marketing</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 410</td>
<td>Accounting and Financial</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>MSOR 485A</td>
<td>Individual Development</td>
<td>1.5</td>
</tr>
<tr>
<td>MSOR 485B</td>
<td>Team Development</td>
<td>1.5</td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

Operations Research Core (12 credit hours)
The Operations Research Core provides the mathematical, statistical and computational skills needed by analysts in research and development groups in manufacturing and service companies and consulting firms.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSOR 402</td>
<td>Stochastic Models with</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Applications</td>
<td></td>
</tr>
<tr>
<td>MSOR 411</td>
<td>Optimization Modeling</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 432</td>
<td>Computer Simulation</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 433</td>
<td>Foundations of Probability</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>and Statistics</td>
<td></td>
</tr>
<tr>
<td>MSOR 435B</td>
<td>Integrated Problem Solving</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>in OR and SC</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

Supply Chain Courses (18 credit hours)
Supply chain courses build upon the business and quantitative foundation to provide advanced knowledge in operations and supply chain management.

Required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSOR 406</td>
<td>Operations Management</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 420</td>
<td>Six Sigma and Quality</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>Total Units</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Elective Options:
Students must choose four departmentally approved elective supply chain courses based on availability, which currently include the following (check with department administrator for current offerings):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSOR 422</td>
<td>Lean Operations</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 450</td>
<td>Project Management</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 475</td>
<td>Supply Chain Logistics</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 476</td>
<td>Strategic Sourcing</td>
<td>3</td>
</tr>
<tr>
<td>MSOR 477</td>
<td>Enterprise Resource Planning</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>in the Supply Chain</td>
<td></td>
</tr>
</tbody>
</table>

For more information, contact Kamlesh Mathur (kamlesh.mathur@case.edu), PhD, chair and professor of operations and faculty director of the MSM-ORSC, at 216.368.3857 or Deborah Bibb (deborah.bibb@case.edu), assistant dean of admissions, at 216.368.6702.

Master of Science in Positive Organization Development and Change (MPOD)
The Master of Science in Positive Organization Development and Change (MPOD) is a unique program created and offered by the world-renowned Organizational Behavior Department at the Weatherhead School of Management. The curriculum attempts to remain on the cutting edge of change management, leadership development, organizational transformation, organizational behavior and societal benefit.

Toward this end, the MPOD program emphasizes strength-based and positive approaches to managing change, designing sustainable institutions, formulating effective strategy, creating high engagement work cultures, leading through emotional intelligence, coaching for high performance, and deep personal and professional development. It will be of value to organizations with aspiring managers who wish to:
• Build new capabilities in strategic-level change interventions that create value for customers and communities
• Broaden their knowledge of leading-edge theory and practice in appreciative inquiry, strength-based human resource development and positive organizational change research
• Develop emotional intelligence competencies needed to coach and foster leadership skills and personal growth in one’s self and others
• Form extraordinary teams and enterprises that enable human flourishing, are economically prosperous and ecologically advanced, and unite strengths with aspirations
• Engage in lifelong experiential learning to realize, develop and model themselves as agents for positive change

The MPOD program is grounded in the basic belief that a person can be a powerful instrument for change, and that personal and professional development go hand in hand. The learning experience will enable participants to become more effective at designing and conducting positive change interventions that have much better chances of success than traditional approaches, to have experiential opportunities to become...
more self-aware, to practice and experiment with new skills, and to give
and receive coaching that can be life changing.

Curriculum
The MPOD program is conducted in five separate week-long residencies
and an international tour spread over 18 months. This residency design
makes the program flexible enough to accommodate the busy schedules
of leaders, managers, and staff professionals, and enables students to
attend school without leaving their employment. The intervening periods
(between program residencies) will involve project and group work, self-
study, assignments, reading and on-line guidance done in collaboration
with the faculty at Case Western Reserve University.

MPOD Residencies

Residency One

<table>
<thead>
<tr>
<th>MPOD 413A</th>
<th>Foundations of Positive Organization Development and Change</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPOD 416A</td>
<td>Leadership, Executive Assessment and Development</td>
<td>1</td>
</tr>
<tr>
<td>MPOD 431</td>
<td>Experiential Learning for Individuals, Teams, and Organizations</td>
<td>3</td>
</tr>
</tbody>
</table>

Residency Two

| MPOD 416B | Leadership and Executive Assessment and Development         | 1 |
| MPOD 435  | Practicum in Appreciative Inquiry and Positive OD            | 3 |
| MPOD 479  | Foundations of Strategic Thinking                            | 3 |

Residency Three

| MPOD 416C | Leadership, Executive Assessment and Development             | 1 |
| MPOD 470A | Leading Change from a Complexity Perspective                  | 1 |
| MPOD 480  | Dynamics of Effective Consulting Strategies                   | 3 |

Residency Four

| MPOD 414  | Organization Design for a Knowledge World                     | 3 |
| MPOD 439A | Individual Field Project                                      | 2 |
| MPOD 470B | Leading Change from a Complexity Perspective                  | 2 |

International Study Tour

| MPOD 498  | Global Citizenship and Multi-Cultural OD: International Study Tour | 3 |

Residency Five

| MPOD 413B | Foundations of Positive Organization Development and Change | 1 |
| MPOD 418  | Flourishing Enterprise                                       | 2 |
| MPOD 432  | Interpersonal Skills Building                                 | 2 |
| MPOD 439B | Individual Field Project                                     | 2 |

Total Units: 36

For more information, please visit the website (http://weatherhead.case.edu/degrees/ms-positive-organization-development)
or contact Patricia Petty (patricia.petty@case.edu), associate director, at 216.368.4642.

Doctoral Programs

Doctor of Management (DM) and PhD in Management: Designing Sustainable Systems

Business leadership is increasingly required to integrate multiple sources
of knowledge, understand the perceptions of diverse parties and put
human values into action. Executives are challenged to create social,
intellectual and economic value for their organizations and for society
at-large based on rigorous and sound evidence. Recognizing these
challenges, Weatherhead offers two doctoral degrees in management for
working professionals: the DM and the PhD in Management: Designing
Sustainable Systems.

The DM is based on the expectation that the practitioner-scholar will
develop the ability to think intensely and critically about problems
confronting an organization, a community, a nation and the world.
Through conceptually modeling these problems, assessing and modifying
the assumptions underlying the models, testing assumptions empirically
and applying modes of thought drawn from many disciplines, students
draw conclusions and propose solutions based on the results their
models produce.

The PhD in Management: Designing Sustainable Systems is focused on
preparing interdisciplinary practitioner-scholars for successful research
and academic careers. Students develop the ability to approach problems
of practice rigorously from multiple disciplinary angles and to produce
sound evidence and theoretical frames to address those problems.

Curricula and coursework in these programs provide a foundation
for conducting rigorous research and practicing evidence-based
management. Courses are interrelated theoretically and methodologically
and prepare students to bring academic, theoretical and empirical
perspectives to bear on problems that they face in their organizations or
in public policy advocacy.

DM

The DM is a 54-credit-hour, three-year, lock-step program with an option
to pursue the Designing Sustainable Systems track in the PhD in
Management. DM students’ research projects are evaluated by a faculty
review committee over the course of the program at critical research
milestones.

Curriculum

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory and Practice of Collective Action (EDMP 611)</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Research Inquiry (EDMP 665)</td>
<td>3</td>
</tr>
<tr>
<td>Leading Change (EDMP 613)</td>
<td>3</td>
</tr>
<tr>
<td>Qualitative Inquiry I (EDMP 638)</td>
<td>3</td>
</tr>
<tr>
<td>Flourishing Enterprise: Creating Sustainable Value for Business and World Benefit (EDMP 672)</td>
<td>3</td>
</tr>
<tr>
<td>Understanding, Designing, Managing Complex Systems (EDMP 673)</td>
<td>3</td>
</tr>
</tbody>
</table>

Year Total: 36
among theoretical constructs. Students learn to frame effective questions for practitioner-scholarship research that embodies inquiry and openness, to align the conceptual framework and research question to the chosen problem of practice and to write scholarly papers that are clear and that present a logical flow of well-supported arguments. By understanding the development of grounded theory and understanding ethnographic observation and field notes, students formally and rigorously analyze qualitative data in an interpretive fashion.

**Capstone**

The Capstone integrates the analytical approaches the student has learned in EDMP 643 Measuring Business Behaviors and Structures and EDMP 649 Causal Analysis of Business Problems II. The Capstone exercise is intended to allow students to demonstrate their independent competence in quantitative inquiry skills and, based on a satisfactory assessment, to progress toward the completion of the quantitative inquiry project, which is a requirement for both the DM and the PhD in Management: Designing Sustainable Systems.

**Quantitative Research Paper**

At the end of the Fall semester of the third year students complete a Quantitative Research Paper. The objective of the quantitative research project is to generate a rigorous and valid quantitative empirical study that is guided by a hypothesized model of the student’s phenomenon of interest. The study must be framed by current theoretical and empirical work within the area of interest. A robust research design is utilized that follows the material covered in the quantitative research courses including collecting and validating data in a way that mitigates biases. The student completes a systematic and rigorous quantitative analysis and interprets the analysis in a way that provides novel insight to the phenomena of interest. The quantitative research paper details the project and is written in a manner that meets high scholarly standards to merit publication in top-rated journals and outlets.

**Integrative Paper**

As a final requirement for the DM dissertation, each student writes an overview statement introducing his or her Qualitative and Quantitative Research Papers, making substantive observations and conclusions about each project, and presenting a personal reflective statement about each project’s significance to the author. The Research Proposal frames the dissertation overview in a preliminary way, but in light of the student’s experience in conducting qualitative and quantitative studies, the synthesis is rewritten, revised and critically evaluated to become the Integrative Paper. The approved Integrative Paper, Qualitative Research Paper and Quantitative Research Paper serve as the dissertation requirement of the DM program.

**PhD in Management: Designing Sustainable Systems**

Weatherhead’s Designing Sustainable Systems track in the PhD in Management (https://weatherhead.case.edu/degrees/phd-management/designing-sustainable-systems) program offers an extension to the DM. This program is for DM students who wish to reorient their careers to formally pursue positions as academic researchers and scholars. DM students can apply for this degree program during their second year in the DM program.

**Research Requirements and Deliverables**

The Qualitative Research Paper presents findings and explanatory concepts from the student’s qualitative fieldwork project. It identifies and frames a potent “phenomenological practice gap” where current practitioner and academic knowledge guide effective practice. The research synthesizes significant scholarly literature into a coherent conceptual framework and an understandable model of relationships
acquire knowledge that leads to grounding in their chosen discipline(s) (for example, marketing, strategy, accounting, information systems, organizational behavior, finance or economics). Students are required to take a comprehensive exam demonstrating knowledge of the field’s theories, research methods and results. Upon passing the comprehensive exam, students are advanced to candidacy for the PhD. Candidates defend their PhD thesis proposal and the final thesis during their course of study.

Doctoral candidates in the PhD in Management: Designing Sustainable Systems track undertake dissertation research during their fourth year of study to extend their contributions to managerial knowledge. Informed by courses in design practices, sustainable value and complex systems thinking, candidates incorporate human values and appropriate mixed methods of analysis into their research. An original and significant endeavor, the dissertation includes a detailed review of the chosen topic, relevant research questions, methods of inquiry used and findings obtained, as well as the implications of these findings.

For more information, contact Sue Nartker (sue.nartker@case.edu), managing director of the DM program, at 216.368.1943; or Marilyn Chorman (marilyn.chorman@case.edu), associate director of the program, at 216.368.3638.

**PhD in Management**

A PhD in management offers students the opportunity to develop theory-driven scholarship that is grounded in practice and explores various dimensions of value creation, and to prepare for a career as a faculty member.

Candidates may specialize in one of three areas:

- Accountancy
- Designing Sustainable Systems
- Design & Innovation

**Accountancy**

The PhD in accountancy is structured and a student study plan is developed to support high-quality research and effective teaching based upon knowledge and skill levels appropriate to a student’s goals. Doctoral students work with faculty whose research investigates matters of importance to academics, practitioners and policy makers, in order to influence practice and standard setting in both the private and public sectors.

**Curriculum**

The first two academic years are directed toward the study of the literature, methods and recent research appropriate to a student’s identified interests. Summer periods are available for individual reading, development and writing along project lines to be determined by the student’s chair and program committee. This two-year period is expected to provide the foundation for preparing well-developed research papers that exhibit knowledge and skill levels appropriate to an individual’s goals as he or she approaches candidacy.

The third year is devoted to writing focused individual papers leading to a dissertation proposal under the supervision of a study program committee. Based on one of these high-quality research papers, a suitable dissertation proposal will be prepared by the end of the third year of study. This research and writing activity will not only help to determine the student’s dissertation topic, but will also be considered equivalent to field examinations. The series of papers leading up to the dissertation proposal, the proposal itself, and an oral presentation to the student’s study program committee will be taken into account as the committee determines whether to grant doctoral candidate status to the student.

The fourth year is focused upon completion of the dissertation. The student will also prepare documents necessary and helpful to the acquisition of a full-time academic appointment. Most students will also be engaged in the revision of submissions of academic work to journals in the accounting discipline. Throughout the program, the student will develop competencies related to classroom and teaching activities as well.

For more information, visit our website (http://weatherhead.case.edu/degrees/phd-management/accountancy) or contact Elaine Iannicelli (elaine.iannicelli@case.edu), department administrator, at 216.368.4141.

**Designing Sustainable Systems**

Please refer to the Doctor of Management (p. 976) section of the Bulletin for more information on the PhD in Management: Designing Sustainable Systems.

**Design & Innovation**

The PhD in design and innovation brings together the disciplines of information systems, strategy and marketing to prepare scholars for path-creating research on consequential issues faced by organizations and managers.

The program encourages a cross-disciplinary approach to the generation of new knowledge on the management challenge of creating value for customers, stakeholders and society. Because traditional boundaries between the economic and the social, between the public and the private, and between management disciplines are becoming blurred, economic elements that had been separate and autonomous are now interconnected and interdependent. As a result, the global market economy requires unrelenting innovations in designing better products, services, interactions and environments.

The guiding principles for PhD studies in the Department of Design & Innovation are:

- To develop scholars with the interdisciplinary theoretical grounding and methodological skills that enable path-creating research on important management problems
- To prepare scholars and educators capable of holding academic positions in top universities and research institutions
- To produce scholars with a reputation as risk-takers who are unafraid to embrace the unconventional and engage in exciting research that informs both disciplinary and interdisciplinary interests
- To train graduates that value partnership with practitioner-scholars who share their interests and engage in joint exploration of research opportunities for publication in top scholarly journals

**Curriculum**

The department’s PhD program is focused on disciplinary research and trains academic scholars for faculty positions in the disciplines of information systems and marketing at leading business schools.

The organizing principles for the program are:

- To provide rigorous interdisciplinary training in theory and methods through core courses
Interested students are therefore encouraged to contact individual faculty that aligns with the research interests of the faculty in the department. GMAT score which exceeds 650, and interest in pursuing a research topic is expected to have strong quantitative abilities. The PhD program consists of coursework in three areas and a dissertation. Coursework in the following areas is required: general management research and methods, specialization research, and a minor area of study. The general management research and methods component involves six courses offering sufficient interdisciplinary orientation:

- Research theory and methods
- Qualitative research methods
- Measurement in management research
- Multivariate data analysis
- Theory building and analysis
- Advanced data analysis

At the end of the first and second years of study, each student will be expected to complete and present a publishable paper that draws from one or more of their courses of study and demonstrates their progress in the program. These papers are expected to be targeted to top academic conferences and academic journals. In addition, students are required to attend the interdisciplinary research seminar series during each year of their study.

Following the completion of all required coursework, students take a comprehensive qualifying examination, generally during the second summer semester or early in the fall semester of the third year. Upon successful completion of the comprehensive qualifying examination, the student is admitted to candidacy and formally begins the dissertation phase of the program. The dissertation proposal and the dissertation itself are generally completed in one-and-a-half to two years. The advising team for each student will be led by a faculty member from the student’s disciplinary focus but is expected to have interdisciplinary representation.

Students making normal progress should expect to finish all degree requirements within four to five years. Students must remain in residence throughout the coursework portion of the program, and the faculty strongly discourages any student from relocating prior to completion of the dissertation as doing so dramatically reduces the likelihood of completing the degree.

Students will be expected to complete a teaching requirement as part of their PhD studies. This requirement includes engaging in teaching responsibilities for at least two full semesters as an instructor of an assigned course and/or assistant assigned to department faculty teaching a course. Teaching responsibilities are governed by department priorities as determined by the chair.

Qualified students generally receive full tuition support for PhD courses taken at Case Western Reserve University. Outstanding students tend to receive financial aid based on research or teaching assistantships. Such assistantships require at least 20 hours of assigned work each week. The department plans to recruit four students every year.

**Student Profile**

Potential doctoral students are expected to have strong quantitative ability, a master’s degree, a minimum of two years’ work experience, a GMAT score which exceeds 650, and interest in pursuing a research topic that aligns with the research interests of the faculty in the department. Interested students are therefore encouraged to contact individual faculty in the department to explore mutual interests. Qualified students will have a demonstrable record of intellectual curiosity, academic excellence and industry experience. We value diversity and encourage students with academic work in basic and social sciences including engineering, health and law to apply, in addition to those with business backgrounds.

For more information, visit our website (https://weatherhead.case.edu/degrees/doctorate/phd-management) or contact Gail Stringer (gcs23@case.edu), department administrator, at 216.365.5326.

**PhD in Operations Research**

The intrinsic complexity of supply chain organizations and the coordination of operational and financial decisions throughout the supply chain are at the heart of the PhD in operations research. Weatherhead’s Operations Department has a rich history as a center of education and scholarship—it was here that the world’s first doctorate in operations research was granted. Candidates learn a unique combination of mathematics, statistics and computer modeling to assist in decision-making for complex organizational problems.

For more information, contact Tedda Nathan (tedda.nathan@case.edu), department administrator, at 216.368.2040.

**PhD in Organizational Behavior**

Weatherhead’s PhD in organizational behavior was the first of its kind. Graduating our first PhD students in 1964, our department set the standard for universities worldwide. United by a passion for generating new knowledge of enduring consequence through scholarly research, inquiry, and writing as well as deeply reflective practice, doctoral students study in a department consistently ranked among the best in the world.

Recipients of our PhD in organizational behavior have taken positions in leading universities and research institutions such as the London School of Business, Columbia University, Stanford University and the Naval Post-Graduate School.

Organizational behavior is a vital and growing field of knowledge that is concerned with human and developmental processes across levels of analysis from individuals and groups through organizations, inter-organizational systems and societies. The academic roots of the field span the disciplines of individual and social psychology, sociology, anthropology, political science and social philosophy. Organizational behavior situates the knowledge and tools of those disciplines in the context of the human dimensions of organizational life.

We approach the study of organizational behavior from the perspective of human possibility, with a special concern for the dynamics and processes of development and for creating new knowledge of individual, group and organizational processes of learning, development and transformation.

**Goals of the Program**

Our educational goals are to prepare PhD students to:

- Observe a doctoral-level foundation in academic areas pertinent to organizational behavior, from the micro to the macro. This interdisciplinary course of study covers key social science domains such as psychology, sociology, learning theory, organization theory, living systems theory, management science and the organizational dimensions of global sustainability and change.
- Master and triangulate rigorous qualitative, quantitative and action-research methodologies in the quest for deep and comprehensive understanding.
• Develop a high level of professional creativity and interpersonal competence, as well as a foundation of professional values and ethics enabling the pursuit of research and teaching in the field, including the facilitation and design of contexts for human development and self-reflective learning, organization development and larger-system transformative change.

Our mission is to provide students with the knowledge, skills and values needed to: (1) conduct the highest quality research and teaching in the field and sub-fields of organizational behavior, and (2) become leading scholars in careers as researchers and educators at the top levels of their specializations and in high-impact areas of society.

Our vision is clear: to be a world-class center of doctoral education—known for our bold ideas, our powerful learning community, and our commitment to value-driven knowledge for the betterment of organizations and the greater good. All of this is in clear and strong alignment with the aim of the Weatherhead School of Management at Case Western Reserve University "to develop transformational ideas and outstanding leaders for the betterment of business and society" and through this environment to have a transformational impact on all who teach, learn, discover and work here, so they are prepared and engaged to advance knowledge and serve humanity.

The philosophy of the Organizational Behavior Department (http://weatherhead.case.edu/departments/organizational-behavior) is rooted in human values. These values guide our behavior as we strive to enhance research, learning and academic excellence amidst the demands and complexities of everyday life. They also reflect the spirit of connectedness among us that gives life to the doctoral learning community as a whole. The following guiding ideas represent our aspirations and our community at our best:

- Knowledge of consequence
- Methodological rigor and variety
- A community of inquiry
- A deep value for diversity and inclusion
- Whole person development
- The life of the mind
- Academic innovation and excellence

Curriculum

Our doctoral program is structured to resonate with our department’s mission of developing world-class researchers and educators interested in doing high quality academic work of enduring consequence. Hence our program and course requirements encourage continual development of reading, writing, research methods, statistical skills and relational skills to help students effectively study and communicate their ideas. Coursework is completed in the first two years of the program, as follows:

Sample Course Schedule

<table>
<thead>
<tr>
<th>Year Total:</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Spring</td>
</tr>
<tr>
<td>First Year</td>
<td></td>
</tr>
<tr>
<td>Organizational Behavior Department Seminar (ORBH 510)</td>
<td>1.5</td>
</tr>
<tr>
<td>ORBH Dynamic Modules (3 each semester)</td>
<td>4.5</td>
</tr>
<tr>
<td>Research Methods I (ORBH 560)</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Statistics: Linear Models (NURS 630)</td>
<td>3</td>
</tr>
<tr>
<td>Second Year</td>
<td></td>
</tr>
<tr>
<td>ORBH Dynamic Modules (3 each semester)</td>
<td>4.5</td>
</tr>
<tr>
<td>Applied Multivariate Data Analysis (MGMT 573)</td>
<td>3</td>
</tr>
<tr>
<td>Elective/Independent Study</td>
<td>3</td>
</tr>
<tr>
<td>Organizational Behavior Department Seminar (ORBH 510)</td>
<td>1.5</td>
</tr>
<tr>
<td>ORBH Dynamic Modules (3 each semester)</td>
<td>4.5</td>
</tr>
<tr>
<td>Elective/Independent Study</td>
<td>3</td>
</tr>
<tr>
<td>Year Total:</td>
<td>12</td>
</tr>
</tbody>
</table>

Total Units in Sequence: 48

The PhD in organizational behavior program is designed for full-time, year-round engagement. Although some students may take shorter or longer to complete the program, it is generally completed in four to five years.

Each semester during the first two years, students participate in the ORBH Dynamic Modules, which are a series of short courses, each meeting once a week for five weeks. These Modules are designed to introduce the knowledge bases and key research of organizational behavior and related fields as well as share the current research interests of the department’s faculty.

Students also participate each semester in the ORBH Research Seminar which is designed to create and sustain an intellectually nourishing and appreciative learning space for the entire community. The ORBH Research Seminar is required for both the first- and second-year cohort groups. It includes gatherings of the department’s learning community of doctoral students and faculty. It provides a forum for discussion and advancement of ongoing research and scholarship through preparation and presentation of Integrative Scholarship Papers, Qualifying Papers, Dissertation Proposals and Dissertation Defenses. Thus the ORBH Research Seminar is a department-wide platform for developing productive and collaborative research relationships and for increasing collective knowledge of the current state of organizational behavior and related fields.
Research Requirements and Deliverables
The coursework is delineated for the first two years of the PhD. This provides a strong theoretical foundation for conducting future research. Other program requirements include the following:

Integrative Scholarship Paper
By the end of the spring semester of the first year, each doctoral student is required to complete an Integrative Scholarship Paper (ISP). This is a critical review and integration of the literature about a topic or problem of interest. It can be thought of as a report on the current state of the scholarly conversation about the topic, encompassing historical perspectives on the evolution of the scholarly conversation to date, an examination of how the topic is approached by different disciplines or schools of thought, theoretical propositions and suggestions for future research. The ISP is reviewed by the faculty adviser and a faculty reader, and upon approval is included in the department’s working paper series. Beyond the first year, students are expected to work with their faculty adviser and others to submit their ISPs for consideration for conference presentation and journal publication during their second and subsequent years of the doctoral program.

Qualifying Paper
During the summer of their second year in the doctoral program, students complete a Qualifying Paper. Generally, this is an initial empirical investigation or meta-analysis of the topic of choice. The student is expected to form a committee, headed by a faculty adviser of the student’s own choosing and two other departmental faculty members who guide the research. Often understood as a mini-thesis or pilot study, the student is expected to produce an in-depth analysis of the research question explored through a relevant method of inquiry. Students are expected to submit their qualifying paper for consideration for conference presentation and journal publication during their third and subsequent years of the doctoral program.

Dissertation
Doctoral students undertake dissertation research after completion of their qualifying paper. Each student forms a committee, consisting of three departmental faculty members (one of whom will be the committee chair) and one faculty member from outside the department but within the university, to guide the research conducted. An original and significant endeavor, the dissertation includes a detailed review of the chosen topic, relevant research questions, research methods, findings obtained and an analysis of their implications.

Though all three deliverables (the ISP, Qualifying Paper and Dissertation) may optimally flow within a single stream of inquiry, the student is free to choose a different topic of interest for each.

For more information, contact Lila Robinson (lila.robinson@case.edu), department administrator, at 216.368.2055.

Dual-Degree Programs

MBA/Doctor of Medicine (MD) Dual-Degree Program
The School of Medicine and Weatherhead collaborate to offer the MBA/MD dual-degree program. The MBA/MD provides physicians with the management knowledge and skills necessary to deal with rapid changes in the healthcare industry and economy. After completion of both degree programs, two separate diplomas are awarded. Coursework for both programs is usually completed within five years, and it must be completed within six years of the date of initial enrollment in either program.

To learn more, contact Weatherhead at 216.368.2030 or wsomadmissions@case.edu, or the School of Medicine at 216.368.3450 or casemed-admissions@case.edu.

MBA/Juris Doctor (JD) Dual-Degree Program
Weatherhead has a formal full-time dual-degree program with the School of Law. Students enrolled in the program who fulfill the requirements set for graduation by both schools will receive both an MBA and a JD degree. The MBA/JD dual-degree program is designed for individuals who want to specialize in the legal, contractual and governmental aspects of management. After completion of both degree programs, two separate diplomas are awarded. Coursework for both programs must be completed within six years of the date of initial enrollment in either program.

To learn more, contact Weatherhead at 216.368.2030 or wsomadmissions@case.edu, or the School of Law at 216.368.3600 or lawadmissions@case.edu.

MBA/Master of Science in Social Administration (MSSA) Dual-Degree Program
The MBA/MSSA dual-degree program is offered in partnership with the Jack, Joseph, and Morton Mandel School of Applied Social Sciences (MSASS) and Weatherhead. The MBA/MSSA dual-degree program is designed for candidates who wish to prepare for advanced social work practice in a variety of direct practice and community practice settings, organizations, while developing the skills to assume management responsibility within those settings. Candidates must apply separately to each program.

To learn more, contact Weatherhead at 216.368.2030 or wsomadmissions@case.edu, or Mandel School at 216.368.1655 msass.case.edu/admissions.

MBA/Master in Public Health (MPH) Dual-Degree Program
The MBA/MPH dual-degree program was developed by the School of Medicine, the School of Graduate Studies and Weatherhead to provide the skills and knowledge necessary for those who wish to attain the following goals:

- A career working with communities to improve the health of their members by identifying and assessing the health needs of the population and planning and implementing programs to meet those needs
- Management and leadership ability to ensure continued economic viability, human development and effective communication for the public health organization and community in which they practice

MBA/MPH candidates must complete separate applications, participate in the required admission tests and be admitted separately to each program. Students will continue to register throughout the program in the school where they first registered.

To learn more, contact Weatherhead at 216.368.2030 or wsomadmissions@case.edu, or the School of Medicine at 216.368.3725 or info@casemph.org.

MBA/Master of Science in Management-Finance (MSM-Finance) Dual-Degree Program
Weatherhead offers a dual-degree program that is ideal for students interested in gaining the management skills to create sustainable value for business and society, along with specialized skills that prepare them
to make immediate contributions in careers in corporation finance, investment banking, equity research, investment management, risk management and corporate consulting.

A student can submit one application to be admitted into the dual-degree program, but will be considered for each program separately. A student currently in the first year of the Weatherhead full-time MBA program can also apply to be admitted into the dual-degree program. A motivated student may be able complete both degrees in just five semesters (https://weatherhead.case.edu/degrees/masters/dual-degree/mba-msm-finance/curriculum).

- Learn breakthrough business concepts from the people who invented them
- Engage with the same faculty ranked first by Business Week in 2010 and 2012 for excellence in undergraduate finance
- Realize cross-disciplinary collaboration making creativity as vital as quantitative analysis
- Receive direct exposure to top employers to learn about career opportunities

To learn more, contact Marybeth Keeler (mxk761@case.edu), program manager, at 216.368.3688.

MBA/Master of Science in Medical Physiology (MS) Dual-Degree Program
The MBA/MS Medical Physiology dual degree is offered by the School of Medicine and Weatherhead School of Management to provide the skills and knowledge necessary for those who wish to attain the following goals:

- Find career opportunities in healthcare consultation, hospital administration, hospital operations, pharmaceutical project management, and more
- Enhance their chances of admission to medical school, osteopathic school, dental school, a PhD program, or other related programs

MBA/MS Medical Physiology candidates must complete separate applications, participate in the required admission tests and be admitted separately to each program. Students will continue to register throughout the program in the school where they first registered.

To learn more, contact Weatherhead at 216.368.2030 or wsomadmissions@case.edu, or the School of Medicine at 216.368.3725 or info@casemph.org.

MBA/Master of Science in Biochemistry (MS) Dual-Degree Program
The MBA/MS in Biochemistry dual degree is offered by the School of Biochemistry Department Liaison and Associate Dean for MBA Programs at the Weatherhead School of Management to determine their appropriate course of study.

To learn more, contact Weatherhead at 216.368.2030 or w (bizadmission@case.edu) or somadmissions@case.edu, or the School of Medicine at 216.368.3578 or wcm2@case.edu

Master of Science in Management–Healthcare (MSM-HC)/Master in Public Health (MPH) Dual-Degree Program
Weatherhead and the School of Medicine collaborate to offer the MSM-HC/MPH dual-degree program. This program integrates into a single unified curriculum, graduate coursework from the healthcare management (MSM-HC) and public health (MPH) programs. The knowledge and skills this coursework develops will prepare students to identify opportunities to improve population health, design effective and sustainable solutions, and effectively manage the execution of those solutions. The goals of this program are to improve the managerial skills of public health professionals and to increase the acumen of health system managers towards issues in population health. Coursework for the joint degree can be completed in two years if undertaken on a full-time basis.

To learn more, contact Weatherhead at 216.368.2030 or wsomadmissions@case.edu, or the School of Medicine at 216.368.3725 or info@casemph.org.

Weatherhead Center
Fowler Center for Business as an Agent of World Benefit
The Fowler Center for Business as an Agent of World Benefit exists to advance the scholarship and practice of flourishing enterprise. It is allied with like-minded initiatives helping all institutions create prosperity while nourishing human and natural systems.

Flourishing Enterprise is about people being inspired every day and bringing their whole selves to work; it’s about innovation arising from everywhere; and it’s about realizing remarkable relationship value with stakeholders—customers, employees, communities, and the biosphere—to create unprecedented, enduring business advantage.
— David Cooperrider

The Fowler Center’s primary focus is on for-profit organizations that use their core activities to create value for society and the environment in ways that create even more value for their customers and shareholders; its primary vehicle for effecting change is Positive Organizational Science and Appreciative Inquiry. We are drawing on expertise and tools such as design, sustainable value, Appreciative Inquiry, and systems thinking to build and maintain prosperity and flourishing.

Underlying the Fowler Center’s strategic positioning are two leadership models that represent an important shift from current thinking in most business organizations. The first leadership model shifts best practices in making the business case for sustainability.

1. From bolt-on to embedded strategies
2. From incremental change to radical innovation
3. From doing less harm to positive impact
4. From serving the well-off to **socially inclusive**
5. From pilot mode to **scaling system change**

The second leadership model shifts the corporate mindset, values, and culture of sustainability:

1. From an exclusively left-brain analytic approach to one that embraces **emotional and spiritual intelligence**.
2. From treating people as fungible economic resources to creating **personal well-being and flourishing in the workplace**.

Companies embracing the notion of “full-spectrum flourishing” as part of their business strategy have seen huge benefits to their bottom line. These findings are reported in recent publications such as *Flourishing Enterprise* (2014), *Dreammakers: Innovating for the Greater Good* (2017) and *Humanistic Management: Protecting Dignity—Promoting Well Being* (2017).

The Fowler Center advances extraordinary business innovation and social entrepreneurship by turning the social and global issues of our day into business opportunities, much as Peter F. Drucker envisioned toward the end of his life. The Fowler Center practices, researches and supports initiatives based on whole-system design for advancing the ‘how-to’ of flourishing enterprise, and works with businesses, organizations, industries, and economic regions to discover the power and promise of flourishing as an innovation engine for doing good and doing well.

**Portfolio of activities**

The Fowler Center conducts research and outreach to support its three major initiatives.

1. The **Global Forum for Business as an Agent of World Benefit Series**: Convenes business and thought leaders from all over the world every three years to contribute to a tipping point in business as a force for good.
2. **AIM2Flourish**: The world’s first higher-education story platform and recognition program celebrating business solutions for the U.N. Sustainable Development Goals.
3. **Quantum Leadership Project**: An action research project exploring leadership practices that help to cultivate broader perception and greater awareness of our interconnectedness to others, nature and future generations. Such practices are the next edge of flourishing enterprise. They help to inspire and engage employees and customers. They increase authenticity, creativity and collaboration. They help to meet new expectations of Millennials and others who want greater meaning and wholeness in their lives, while helping businesses to ‘Do Well by Doing Good.’

The research activities of the Fowler Center include teaching cases as well as books, book chapters, and journal articles on Appreciative Inquiry, sustainable value, design, embedded sustainability and flourishing enterprise. To carry out its agenda, the Fowler Center relies in part on its Fowler Center Fellows and Distinguished Fellows.

The outreach activities seek to engage businesses through various outreach projects such as Appreciative Inquiry Summits and Sustainable Value workshops. When “in scope” and financially advantageous, the Fowler Center provides advisory services to companies who are looking to further integrate sustainability into their businesses.

The leadership of the Fowler Center is built on the vision and work of David Cooperrider, Ron Fry, Chris Laszlo and other faculty at the Weatherhead School of Management, working in close collaboration with the Fowler Center’s Advisory Board members and other leaders in the Case Western Reserve University community.

To learn more or to find out how you or your organization can get involved with the Fowler Center, visit our website (http://weatherhead.case.edu/centers/fowler) or contact the Fowler Center at 216.368.2160.

**Policies**

**Registration and Academic Standards for Graduate Students**

**Class Attendance**

Students are expected to attend all scheduled class meetings for the courses in which they are registered. Students should notify faculty when they are forced to miss a class because of extenuating circumstances. Faculty should report excessive absences to the program’s faculty director. Students who are not on the class roster for a course are not permitted to attend the course.

**Course Loads**

The university requires students to be registered for a minimum of nine credit hours to maintain full-time student status. Weatherhead requires students to register for and complete courses as specified in their cohort program curriculum plan to continue in their program and maintain any scholarship granted. Failure to adhere to the program curriculum plan may result in separation from the program.

Part-time MBA cohort students register for between three and nine credit hours per semester. Non-cohort part-time students are those who entered the part-time MBA program in the 2009 fall semester or prior, transferred in during the 2010 summer semester or prior, or transitioned from non-degree to degree-seeking status prior to the 2010 fall semester. Non-cohort students must complete 48 credit hours, consisting of 10 required courses and six electives. The 48 hours must be completed within six years of starting the program.

**Course Registration**

A student may enroll during each registration period through the last day of late registration, as set by the official university calendar (https://www.case.edu/registrar/calendar). Exceptions will be granted only upon the recommendation of the dean of Weatherhead. A fee of $25 is charged during the late registration period.

To register, students must have a clear balance unless they are participating in the Bridge Loan Program. Students eligible for the Bridge Loan Program need to submit a company tuition reimbursement letter, Bridge Loan application and fee each semester. Students register online using the Student Information System (SIS). Students who wish to apply for federal loans should visit the FAFSA website (http://www.fafsa.ed.gov).

During any semester, a student may not register in more than one career in SIS, unless the student is in a dual-degree program.

If at any time a student fails to register in two consecutive semesters, excluding the summer session, the student must reapply for admission to Weatherhead, unless prior approval was granted by the Weatherhead registrar.
Degrees Conferred
Case Western Reserve University grants degrees to qualified candidates three times per year: in August, for students who complete their programs during the summer semester; in January, for students who complete their programs during the fall semester; and in May, for students who complete their programs during the spring semester.

There is only one diploma ceremony (http://case.edu/events/commencement) each year, in May, and all candidates are invited to march at this ceremony, regardless of the month in which their degree was awarded. May degree candidates receive their diplomas the day of the ceremony. May degree candidates who do not participate in the ceremony can choose to have their diploma mailed to them or can collect it at the Weatherhead registrar’s office. January and August degree recipients can have diplomas mailed or held for pick up. Students may not receive diplomas prior to the date on which the degree is to be granted.

Extra Assignments
No student is permitted to do extra assignments beyond the work assigned to all students in a course, in order to obtain a higher grade. This policy applies to changing an I grade to a regular grade or to changing one regular grade to another. However, faculty may replace or substitute assignments for individual students in a course, based on extenuating circumstances.

Grades

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Meaning</th>
<th>Quality Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Excellent</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>Good</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>Fair</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>Passing</td>
<td>1</td>
</tr>
<tr>
<td>F</td>
<td>Failure</td>
<td>0</td>
</tr>
<tr>
<td>I</td>
<td>Completion of the first semester of a two-semester course</td>
<td>No degree credit awarded</td>
</tr>
<tr>
<td>P</td>
<td>Pass</td>
<td>0</td>
</tr>
<tr>
<td>NP</td>
<td>No pass</td>
<td></td>
</tr>
<tr>
<td>AD</td>
<td>Successful audit</td>
<td>No degree credit awarded</td>
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<tr>
<td>NG</td>
<td>No grade, unsatisfactory audit</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>Withdrawal from a class</td>
<td>No degree credit awarded</td>
</tr>
<tr>
<td>WD</td>
<td>Withdrawal from all courses in a semester</td>
<td>No degree credit awarded</td>
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Midterm Grades

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<tr>
<th>Letter Grade</th>
<th>Meaning</th>
<th>Quality Points</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Satisfactory</td>
<td>0</td>
<td>No degree credit awarded</td>
</tr>
<tr>
<td>U</td>
<td>Unsatisfactory</td>
<td>0</td>
<td>No degree credit awarded</td>
</tr>
</tbody>
</table>

Grade of Incomplete (I)
The grade I is assigned at the discretion of an instructor, provided that two criteria are met:

- There are extenuating circumstances, explained to the instructor before the assignment of the grade, which clearly justify an extension of time beyond the requirements established for other students in the class. It is the student’s responsibility to notify the instructor of the circumstances which prevent completion of the course.
- The student has been passing the course and only a small segment of the course, such as a term paper, remains to be completed, for which the extenuating circumstances justify a special exception.

In order to receive credit for an I, the student must complete the work by the date specified by the instructor, and no later than the end of the next regular semester (fall or spring semester).

In the absence of notification or adequate justification, the I will automatically change to F or NP (depending on the grading basis for the course) on the stated deadline.

If the student wishes to petition to extend a grade of I beyond the stated deadline, the student must obtain approval from the faculty member who assigned the I, and from the program’s faculty director, before the deadline. A request must be made in writing, preferably via email, and convey (a) the extenuating circumstances justifying the extension and (b) the expected date of completion of the work. If approved, the request should be initialed by the faculty member and delivered by the student to the faculty director for approval and then to the Weatherhead registrar.

Failure to complete course requirements by the extended date will result in a grade of F or NP, depending on the grading basis for the course.

Graduation Requirements
A cumulative GPA of 2.5 in all graduate courses taken for credit in the MAcc, MBA, MPOD and MSM degree programs is required for graduation. Candidates must submit an application for graduation in SIS no later than two months before the graduation date at which their degree is expected to be awarded. The candidate is responsible for filing the application.

Upon receipt of the student’s application, the Weatherhead registrar will verify the student’s eligibility for graduation at the anticipated date. Students are advised to contact the Weatherhead Registrar’s Office (https://cwru.az1.qualtrics.com/jfe/form/SV_7PVYg9B9992N0d) if they have any questions regarding requirements for graduation.

Leave of Absence
If a student will not be taking classes for more than one semester, the student should request a one year leave of absence. Approval for any leave of absence from a degree program must be requested in writing by the student. This request for approval should be submitted to the faculty director of the program and the Weatherhead registrar. Unapproved interruption in the program sequence constitutes separation from the program.

Retroactive leaves of absence are not permitted. Students who fail to return upon completion of a leave of absence need to re-apply to the degree program. Students must graduate within six years from the start of their first semester at Weatherhead. A leave of absence does not extend the maximum time permitted for the completion of degree requirements. A leave of absence cannot be taken if students are on an approved extension of the time limit to complete their degree.
Registration

Students generally register for classes and make changes to their schedule using SIS. Step by step information on registering for classes is available online (http://www.case.edu/registrar). For assistance with this process, students must contact the Weatherhead registrar (https://cwru.az1.qualtrics.com/jfe/form/SV_7PVYgBy99IZNdj) at 216.368.5900 before the last day of the drop/add period.

Repeat Policy

In general, Masters students can take a course for credit only one time. Students who earn a grade of F in a core course must repeat the course, or an equivalent course as approved by the faculty program director. Graduate students can repeat Curricular Practical Training, Independent Study/Special Problems and Topics and International Institute/study abroad electives. Full semester study abroad experiences at an international school are not repeatable. DM students who earned a grade of NP in a doctoral course are required to repeat the course and earn a P.

Residency

For the EMBA program:

In-person presence at each residency is critical for success in the EMBA program. Students are expected to attend each residency and each class. If unavoidable absences arise, these should be approved in advance and accommodation should be reached with the faculty member(s) in question to make up the content. In addition to regularly scheduled classes, students can expect to attend frequent meetings with small groups formed at the start of the program.

For the MPOD program:

In-person presence at each residency is critical for success in the MPOD program. Students are expected to attend each residency and each class and to participate throughout the program with classmates in small groups, team projects and practicums. If unavoidable absences arise, these should be approved in advance and accommodation should be reached with the faculty member(s) in question to make up the content.

Retention Requirements

All students are required to follow their curriculum plan and graduate with their cohort. If at any time a student fails to register in two consecutive semesters, excluding the summer session, the student must reapply for admission to Weatherhead, unless prior approval was granted by the Weatherhead registrar.

For the MAcc, MBA and MSM degree programs:

- A cumulative GPA of 2.5 is needed to maintain good standing
- A cumulative GPA below 2.5 will result in probation
- A cumulative GPA below 2.5 in two different semesters will result in separation from the program
- An earned F received in any class will result in separation from the program

For the MEM degree program:

- Students must maintain an overall GPA of 2.75 to remain in the program
- Any student admitted to the program on a conditional basis must demonstrate a minimum GPA of 2.75 in the first semester (the summer semester) to continue
- Should a student fall below the 2.75 GPA threshold, he or she will have one semester to restore his or her GPA to 2.75, which is required for graduation

Transcripts

Case Western Reserve University considers grades and other information about a student’s performance at the university to be private matter and will release such information to the student only upon written request. Transcripts will not be issued to or on behalf of a student who has not discharged all financial obligations to the university. Transcripts are issued by the University Registrar’s Office. Requests can be made online (http://www.case.edu/registrar/transcripts.html) or in person or by mail using this form (http://case.edu/registrar/media/caseedu/registrar/documents/forms/transreq.pdf).

Transcripts of work completed at other institutions will not be released to the student or other third parties.

Transfers and Waivers

No transfers, waivers or substitutions are accepted for full-time MBA, EMBA, MPOD or MAcc.

For MSM-Finance, MSM-ORSC and MSM-Business Analytics:

Upon approval of the faculty program director, MSM-Finance, MSM-ORSC and MSM-Business Analytics students may substitute up to 9 credit hours of coursework if comparable CWRU courses have been completed.

For MSM-Healthcare:

Students may transfer up to 6 credit hours of prior course work from an AACSB-accredited university to replace elective classes only with approval from the faculty director and the Weatherhead registrar. No course in which the student received a grade lower than a B will be accepted. Graduate courses counted toward another degree are not eligible for transfer credit. Courses completed more than 5 years prior to the start of the MSM-Healthcare program are not eligible for transfer credit. If a transfer credit request is approved, upon completion of the course, it is the student’s responsibility to provide the Weatherhead Registrar’s Office with an official transfer transcript. Courses cannot be transferred without an official transfer transcript. Quarter hours convert to semester hours with a conversion of 0.67 semester hours for every 1.0 quarter hours.

For part-time MBA:

Students who entered the program in fall 2011 and after may transfer up to 6 credit hours of prior course work from an AACSB-accredited university to replace elective classes only with approval from the faculty director and the Weatherhead registrar. No course in which the student
received a grade lower than a B will be accepted. Graduate courses counted toward another degree are not eligible for transfer credit. Courses completed more than 5 years prior to the start of the MBA program are not eligible for transfer credit. If a transfer credit request is approved, upon completion of the course, it is the student’s responsibility to provide the Weatherhead Registrar’s Office with an official transfer transcript. Courses cannot be transferred without an official transfer transcript. Quarter hours convert to semester hours with a conversion of 0.67 semester hours for every 1.0 quarter hours.

Legacy part-time students who entered the part-time MBA program prior to the 2011 fall semester must complete the Petition for Transfer Credit Form and submit the required accompanying documents (a current course description and the course syllabus). Core courses are not eligible for transfer credit. Transfer approval in this case is required from the Weatherhead registrar, the faculty program director, the department chair and the Dean’s Office. Legacy part-time students should contact the Weatherhead Registrar’s Office for the Petition for Transfer Credit Form.

Withdrawals
To withdraw from courses during a semester, the student may either initiate a request to withdraw in SIS or contact the Weatherhead registrar (https://cwrui.qualtrics.com/jfe/form/SV_7PVy9gB99ifNjd) before the last day of classes. All withdrawals after the official drop/add periods will result in a grade of W (WD if withdrawing from all classes) on the student’s transcript. A student withdrawing after the last day of classes will receive the grade of F unless, in the judgment of the program’s faculty director, there are valid reasons for recording the grade of W.

Failure to attend class, giving notice to the instructor, or nonpayment of fees will not be regarded as official notice of withdrawal. A grade of F will be assigned in each course from which the student has not officially withdrawn.

Note: A student is not entitled to any tuition adjustment for a single course dropped after the drop/add deadline. However, if a student is forced to withdraw from all coursework for the semester due to unavoidable and unforeseen circumstances, he or she may petition (in writing to the Weatherhead registrar) for a partial tuition refund. Tuition charges for withdrawals after the official drop/add deadline are prorated based upon the week of withdrawal and according to the withdrawal and refund schedule (http://case.edu/studentaccounts/fees/refund) published by Student Financial Services (http://case.edu/studentaccounts).

Academic Integrity Policy
This policy comprises the standards of academic integrity in the graduate programs of the Weatherhead School of Management at Case Western Reserve University and sets forth the procedures to be followed by the dean, faculty and staff in cases in which students are alleged to have violated the Academic Integrity Policy. This policy does not address alleged violations and disciplinary actions in the undergraduate programs. Such matters are addressed at the university level.

Academic integrity is vital to the Weatherhead graduate programs’ learner-centered approach to management education. A deep commitment to learning and honesty on the part of every student is crucial. Every student is expected to respect the learning process, to enhance it and to strenuously avoid any activity that might corrupt it. Students are required to report observed violations of the Weatherhead code of academic conduct. Faculty, the dean and administration also have a crucial role in upholding academic integrity at Weatherhead and ensuring adherence to general principles of academic integrity and this policy.

To foster a well-informed commitment to academic integrity, the following policies govern the Weatherhead learning environment:

1. All forms of dishonesty including cheating, plagiarism or knowingly furnishing false information to Weatherhead faculty or administrators are prohibited. This standard is to be interpreted strictly. Examples of violations of the code of academic conduct include, but are not limited to:
   • Communication or use of aids not specifically authorized by the instructor during examinations. Such instances include giving or receiving unauthorized assistance in any form (including the use of unauthorized aids, copying from another student’s work, or giving, soliciting or receiving unauthorized aid)
   • Submission of work prepared for another class, for another section of the same course in the same or prior years, or by other students without the prior authorization of the course instructor
   • Submission of texts or partial texts prepared by anyone other than the student (plagiarism), including material from the internet, without proper attribution, including whether the true author is aware of or condones the act. Plagiarism can occur inadvertently due to the omission of proper credit and includes failure to properly footnote sources, to indicate quoted or paraphrased material or to credit others for their ideas, words or work
   • Misrepresentation on a resume, Weatherhead application materials or any other official document.

2. Computer software is private intellectual property; therefore, copying university-owned or licensed software or data, or loading such software onto another computer system for personal or external non-CWRU use without prior written approval is prohibited. The modification of university-owned or licensed software or data without prior written approval is prohibited.

3. Information technology, including computers, data transmission and storage technology are essential to knowledge production and learning. Damage or disruption to the operation of computer equipment, data communications equipment or data communications lines is prohibited. The use of university-owned or licensed computers for non-educational purposes or for purposes for which they were not intended is prohibited.

Academic Integrity Officer and Associate Academic Integrity Officer
To maintain and consolidate information on prior academic integrity violations and associated consequences, prior to each academic year, Council will designate one Academic Integrity Officer (AIO) and one Associate Academic Integrity Officer (AAIO) from the full-time faculty to serve a term of one year of service during the coming academic year, renewable up to five years based upon the respective individuals’ willingness and ability to fulfill the respective roles. Council will carefully consider the fit between the workload demands of the AIO and AAIO and the characteristics of the individuals, including such things as the individuals’ tenure, rank and previous involvement in other Weatherhead committees related to Weatherhead curriculum. To fulfill the responsibilities of the AIO, the individual will be provided with the appropriate administrative support.

The AIO is the first contact for allegations of violations of the code of academic conduct, as explained below. The AAIO is appointed for two purposes. First, the AAIO serves as a backup for the AIO in the event that conflicts of interest or other obligations prevent the AIO from fulfilling...
Disciplinary Hearings

AIO duties in a given case. Second, Council selects the AAIO with the idea that the AAIO may become the succeeding AIO when the AIO's term is concluded, whereupon Council will designate a replacement AAIO. The expectation is that the AIO and the AAIO will work together on academic integrity issues that arise.

If a student witnesses an activity that appears to violate the code of academic conduct, that student must take proper action to address or curtail the activity. Proper action may include confronting the individuals involved, requesting that the instructor clarify the guidelines for appropriate conduct, and reporting the activity to the instructor or the AIO. Provision will be made for an anonymous reporting channel as necessary.

In the event that a faculty member has reasonable grounds to suspect that a student has violated the Weatherhead Code of Academic Conduct, the faculty member must consult the AIO. The purpose of the consultation is fourfold: (1) to provide the faculty member with an awareness of precedents for the violation in question, (2) to maintain consistency across departments in the Weatherhead, (3) to determine whether the student has prior violations and (4) to allow the faculty member and the AIO to determine whether additional information should be gathered about the alleged incident and by whom. If the student has had prior offenses, a hearing must be conducted.

A faculty member may resolve the violation without a hearing if the following four conditions are met: (1) the incident and sanction have been reported to the AIO, (2) the student admits to the violation, (3) based on the best information available, it is the student's first violation and (4) the student accepts the sanction proposed by the faculty member. If the student does not accept the faculty member's proposed sanction, the student has one week from that refusal to request a hearing. The minimum sanction in such cases is failure in the course in which the violation occurred. In addition, any student guilty of an academic integrity violation shall not be permitted to participate in the evaluation process for either the faculty member(s) who brought the allegation or the course in which the violation occurred.

If any one of the four conditions noted above is not met, or if the faculty member concludes that the seriousness of the offense warrants a hearing, a hearing must be convened in accordance with the procedures outlined below. In addition, students found guilty of an academic integrity violation shall not have the same rights as other students to participate in the course/instructor evaluation process. A separate policy document regarding this can be obtained from the AIO.

If a hearing is warranted then a maximum penalty can include failure in the course and expulsion.

Procedures for Conducting Academic Integrity Disciplinary Hearings

Initial Steps
1. The faculty member or other individual alleging the academic integrity violation shall prepare a written, signed statement containing a description of the acts constituting the alleged violation of the Code of Academic Conduct, including dates, times, locations and names of individuals involved. The written statement shall include all supporting evidence that is pertinent to the alleged violation.

2. The individual shall submit the statement to the AIO. The AIO will review the statement to determine whether the written statement contains sufficient information to warrant further investigation. The AIO shall also notify the university’s Office of Student Affairs of the matter. The AIO can continue to consult the university’s Office of Student Affairs to the extent appropriate.

3. If the AIO determines that further investigation is warranted, the AIO may request that other parties prepare written statements describing their knowledge of the alleged violation of the Code of Academic Conduct.

4. The AIO shall notify the student of the allegations and that a hearing will be scheduled, which will provide the student with the opportunity to prepare a defense against the allegations and to have an adviser present at the hearing.

Hearing Process
1. After receiving all written statements and any other pertinent information, the AIO shall convene an ad hoc hearing committee comprised of the following individuals: (a) one student, and (b) two full-time regular faculty members. One non-voting administrative staff member shall also attend to take minutes of the proceeding. The members of the committee will elect one member to serve as chair with the staff member recording the minutes. The AIO shall approach student government and allow that organization to nominate the student representative. If student government does not respond, the AIO shall appoint a student representative.

2. Prior to the hearing, the ad hoc hearing committee members will be provided with the written documents concerning the alleged incident and any other pertinent information.

3. The ad hoc hearing committee will establish a hearing date and communicate the date to all parties involved. Prior to the hearing date, the student in question shall have access to all written documents and any other information the ad hoc hearing committee has reviewed. For these purposes the committee should be aware that privacy concerns or related legal issues may prevent the sharing of certain information with the student. For example, cases may arise in which the sharing of certain information may violate the Family Education Rights and Privacy Act (FERPA). In such cases, the committee will consult with the university’s legal counsel.

4. All members of the ad hoc hearing committee must be present at the hearing.

5. The student may be accompanied and assisted by an adviser. The adviser shall not be permitted to participate in the hearing except to advise the student.

6. The faculty member bringing the academic integrity matter to the hearing ordinarily must be present at the hearing. However, if the AIO determines that no material issue of fact exists, the faculty member's presence is not required.

7. Minutes of the hearing will be recorded by the staff member referenced in item 1 of this section.

8. The student shall have the opportunity to argue his or her defense and to present supporting evidence and witnesses. The student shall have the opportunity to hear and question witnesses against him or her by directing all such inquiry through the person chairing the meeting.

9. The hearing committee shall have the authority to reasonably limit the time for testimony for each witness, including the testimony of the student in question.

10. After the hearing, the committee shall convene to discuss the information presented. The committee shall make a written recommendation at this time. The recommendation shall be made to the dean no later than one week after the hearing. The dean will make the final decision regarding the outcome of the hearing.
11. The recommendation may include discipline up to and including expulsion. The student will receive a copy of the committee’s recommendation.

Sanctions and Appeal Process
1. The dean shall have the authority to accept, reject or modify the hearing committee’s recommendation, after consultation with the AIO and, if possible, the AAIO. The student shall have the right to present in writing his or her basis for requesting acceptance, rejection or modification. The dean shall communicate his or her decision in writing to the student and the committee.
2. In no event will a student be suspended from classes or expelled prior to a final resolution of the charges, except in cases where the dean believes the student’s presence on campus presents a risk to the university community.
3. The procedures set forth herein do not preempt the jurisdiction and disciplinary processes of other university bodies that retain their own concurrent jurisdiction to investigate and enforce their own rules and impose their own disciplinary measures. In circumstances in which different disciplinary findings or measures may be imposed by different bodies, the more severe shall have precedent.
4. A student found in violation of the academic integrity policy has the right to appeal the original decision to the Provost’s Office according to the following procedures: An appeal of a decision must be submitted in writing and postmarked or hand-delivered to the provost or the provost’s designee within 10 calendar days after the date on which written notice of the decision was sent to the student. Each student shall be limited to one appeal. The decision of the appeal officer is final.
5. An appeal may be based only upon one or more of the following grounds: (a) procedural error, (b) misapplication or misinterpretation of the rule alleged to have been violated, (c) findings of facts not supported by a preponderance of evidence, (d) discovery of substantial new facts that were unavailable at the time of the hearing, or (e) that the disciplinary sanction imposed is grossly disproportionate to the violation committed.
6. The appeal officer shall dismiss the appeal if the appeal is not based upon one or more of the grounds set forth in section 5 immediately above. The appeal officer may decide the appeal based upon a review of the record. The appeal officer may request additional written information or an oral presentation from any relevant person(s) and then decide the appeal based upon the enhanced record.
7. The appeal officer may, after a review of the record, uphold the original sanction, dismiss the original sanction or impose a lesser sanction. An appeal officer may also remand the case to the original hearing body or refer the case to a new hearing officer or panel to be reheard. If possible, the new hearing officer or panel should be different from the one that originally decided the case. If a case is reheard by a hearing officer or panel, the sanction imposed could be greater or lesser than that imposed at the original hearing.
8. A student and hearing officer may agree in advance to minor deviations from procedure. Such deviations are not then subject to appeal. Other minor deviations are acceptable as long as such deviations are not found upon appeal to be unreasonably harmful to the student.

Standards of Conduct Beyond Academic Integrity
In addition to the standards set forth in the Academic Integrity Policy, Weatherhead students are subject to the university’s Standards of Conduct (http://students.case.edu/handbook/policy/conduct). All students are expected to make themselves aware of those standards and refrain from engaging in any prohibited activities.

A student accused of any of the listed prohibited activities may be referred to the disciplinary conduct procedures described below.

Disciplinary Conduct Procedures

Initial Steps
1. The student, faculty member or member of staff making the allegation shall prepare a written and signed statement containing a complete description of the acts constituting the violation of the university Standards of Conduct, including dates, times, locations and names of individuals involved.
2. The written statement must be directed to the dean of Weatherhead who may choose a designee to administer the disciplinary proceedings. The dean or designee shall review the statement to determine whether the written statement contains enough information to warrant further investigation. The dean or designee shall also notify the university’s Office of Student Affairs of the matter. The dean or designee and university Office of Student Affairs will work collaboratively on this matter to the extent appropriate.
3. If the dean or designee determines that further investigation is warranted, he or she may require that other parties involved make a written statement describing their knowledge of the incident. The student in question will be notified in writing of the nature of the charges against him or her.
4. The student will be notified that a hearing will be scheduled and that he or she will have the opportunity to defend himself or herself against the allegations and to have an adviser present at the hearing.

Hearing Process
1. After receiving all written statements and any other pertinent information, the dean or designee shall convene an ad hoc hearing committee consisting of two elected student officers, two full-time faculty members and one administrative staff member. The members of the committee shall elect one member to serve as chair.
2. Prior to the hearing, the hearing committee will be provided with the written documents concerning the alleged incident and any other pertinent information.
3. A hearing date will be decided upon and communicated to all parties involved. Prior to the hearing date, the student in question shall have access to all written documents and any other information the hearing committee has reviewed, unless the committee decides that it would be inappropriate to provide certain information to the student.
4. On the hearing date, all members of the hearing committee must be present.
5. The student may be accompanied and assisted at the hearing by an adviser. The adviser shall not be permitted to participate in the hearing except to advise the student.
6. Minutes of the hearing will be recorded.
7. The student shall have the opportunity to argue his or her defense and to present supporting witnesses. The student shall have the opportunity to hear and cross-examine witnesses against him or her by directing all such inquiry through the meeting chair, unless the committee deems that it would be inappropriate to permit cross-examination for certain witnesses.
8. The hearing committee shall have the authority to limit the time for testimony for each witness, including the testimony of the student in question.

9. After the hearing, the committee shall convene to discuss the evidence presented and to make a written recommendation. The recommendation will be made to the dean or designee no later than one week after the hearing.

10. The recommendation may include discipline up to and including suspension and expulsion. The student shall receive a copy of the committee's recommendation.

Sanctions and Appeal Process
1. The dean or designee shall have the authority to accept, reject or modify the hearing committee's recommendation. The dean or designee shall communicate his or her decision in writing to the student and the committee. The student shall have the right to present, in writing, a request for acceptance, rejection or modification no later than one week after receiving the decision.

2. In no event will a student be suspended from classes or expelled prior to a final resolution of the charges, except in cases where the dean or designee believes that the student’s presence on campus presents a risk to the university community.

The procedures set forth herein do not preempt the jurisdiction and disciplinary processes of other university bodies, which retain their own concurrent jurisdiction to investigate and enforce their own rules and impose their own disciplinary measures. In circumstances where different disciplinary findings and/or measures may be imposed by different bodies, the more severe sanction shall take precedence.

Grievance Procedures
Staff and faculty members have an important role to play in supporting the best possible learning environment. In the event that a student feels unjustly affected by a non-disciplinary academic or administrative action, he or she may grieve the action or decision in the following manner:

1. The student should bring his or her complaint directly to the person responsible for the action in question. The student should make an effort to resolve the problem informally.

2. If efforts at informal resolution of the problem are not successful, the student shall prepare a written statement within a reasonable period of time after the action or decision that gives rise to the grievance. The statement shall contain the following:
   - Date of the grievance
   - Brief description of the alleged unjust academic or administrative action or decision
   - Names of individual(s) involved
   - Explanation of previous attempts to resolve the problem(s)
   - Action(s) that the student believes should be taken to resolve the problem

3. The written statement shall be directed to the Student Services Specialist.

4. The dean or dean's designee may request that the individual(s) named in the grievant’s written statement prepare a written statement responding to the grievant.

5. Upon receiving the written statements, the dean or designee shall convene an ad hoc committee consisting of one student and two full-time faculty members.

6. The committee shall consider the written statements of the individuals involved and any other information they deem relevant. The committee may interview the individuals involved, including the grievant.

7. The committee shall make a written recommendation to the dean or designee and furnish a copy to the grievant.

8. The dean or designee may accept, reject or modify any or all of the committee’s recommendations. The dean or designee shall make the final decision as to the grievance and shall communicate the decision to the grievant in writing.

All grievances will be held in strictest confidence by all involved. The grievance process cannot be used to circumvent the disciplinary process and procedures set forth elsewhere in this document.

Honors and Awards
Graduate Student Leadership Awards
All Weatherhead graduate students, faculty and staff may nominate graduating students for the student awards. Finalists are chosen from among the nominees and recipients are elected by graduating students.

The Rita Kicher Award is presented to a graduating part-time student at Weatherhead. The award recipient is recognized as an outstanding colleague in Cleveland’s professional community by his or her peers and supervisors, is an active member of community nonprofit organizations, contributes to one or more professional societies or organizations, demonstrates leadership qualities and promotes Weatherhead in a positive way.

The Scott S. Cowen Student Leadership Award is presented to a Weatherhead graduate student who serves as a leader and role model for all students. The recipient promotes the Weatherhead image in a positive way, contributes to the total community and stimulates the classroom experience.

The Student Life Award is presented to a Weatherhead graduate student who actively participates in and supports Weatherhead student activities and events; encourages and supports student participation in student life activities; and creates, revitalizes or provides added value to Weatherhead student organizations, activities or programs.

The Theodore M. Alfred Distinguished Service Award is presented to a Weatherhead graduate student who participates in community service inside and outside of Weatherhead, brings community service opportunities to Weatherhead and promotes external service opportunities.

Awards presented independent of nominations are:

- The Dean’s Academic Achievement Award to those students attaining the highest GPA in their respective degrees.

- Beta Gamma Sigma - Master's students graduating in the spring who are in the top 20 percent of their graduating class (summer, fall and spring graduates) are invited to join in the semester they complete their program. Master’s students graduating in the summer and fall who are in the top 20 percent of their graduating class (summer, fall and spring graduates) are invited to join in the spring semester.
following completion of their program. Doctoral students graduating in the spring are invited to join in the semester they complete their program. Doctoral students graduating in the summer and fall are invited to join in the spring semester following completion of their program.

Weatherhead School of Management Faculty

Accountancy Faculty

Heidi Blakeway-Phillips, MBA
(London School of Business and Columbia Business School)
Visiting Assistant Professor

Leon W. Blazey Jr., CPA
(Western Reserve University)
Professor, Accountancy

Karen W. Braun, PhD, CPA
(University of Connecticut)
Professor, Accountancy

Anthony Bucaro, PhD, CPA
(University of Illinois at Urbana-Champaign)
Assistant Professor, Accountancy

Melissa Carlisle, PhD, CPA
(Georgia Institute of Technology)
Assistant Professor, Accountancy

Dennis Conrad, MAcc, CPA
(Case Western Reserve University)
Associate Professor, Accountancy

Timothy J. Fogarty, PhD, JD, CPA
(Pennsylvania State University, State University of New York at Buffalo)
Professor, Accountancy

Gregory Jonas, PhD, CMA
(Virginia Commonwealth University)
Associate Professor, Accountancy

Thomas A. King, DM, CPA
(Case Western Reserve University)
Professor, Accountancy

Sharon L. Martin, MBA, CPA
(Baldwin Wallace University)
Associate Professor, Accountancy

Gary J. Previts, PhD, CPA
(University of Florida)
Distinguished University Professor; E. Mandell de Windt Professor of Leadership and Enterprise Development; Professor, Accountancy

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Andrew D. Braden Professor of Accounting and Auditing; Chair and Professor, Accountancy

Banking and Finance Faculty

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Assistant Professor, Banking and Finance

Scott A. Fine, MBA
(Stanford University)
Professor, Banking and Finance

Anurag Gupta, PhD
(New York University)
Associate Dean, Global Initiatives, Professor, Banking and Finance

CNV Krishnan, PhD
(University of Wisconsin-Madison)
Chair and Professor, Banking and Finance; Faculty Director, MSM-Finance

Leonardo Madureira, PhD
(University of Pennsylvania)
Deborah and David Daberko Fellow; Associate Dean, Research; Associate Professor, Banking and Finance

William Mahnic, MBA
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Associate Professor, Banking and Finance

Joonki Noh, PhD
(Emory University & University of Michigan)
Assistant Professor, Banking and Finance

Ralitsa Petkova, PhD
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Associate Professor, Banking and Finance

Peter Ritchken, PhD
(Case Western Reserve University)
Professor, Banking and Finance

J.B. Silvers, PhD
(Stanford University)
John R. Mannix Medical Mutual of Ohio Professor of Health Care Finance; Professor, Banking and Finance

Li Wang, PhD
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Design & Innovation Faculty

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Professor, Design & Innovation

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Sayan Chatterjee, PhD  
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Fred Collopy, PhD  
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Professor, Design & Innovation

Steven P. Feldman, PhD  
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Professor, Design & Innovation

Somali Ghosh, PhD  
(State University of New York Binghamton)  
Assistant Professor, Design & Innovation

James Gilmore  
(University of Pennsylvania)  
Assistant Professor, Design & Innovation

Michael Goldberg, MBA (University of Pennsylvania), MA (Johns Hopkins University)  
Assistant Professor, Design & Innovation

Jennifer L. Johnson, MBA  
(Case Western Reserve University)  
Associate Dean, Undergraduate and Integrated Programs; Associate Professor, Design & Innovation

Kalle J. Lytinenen, PhD  
(University of Jyväskylä)  
Chair and Professor, Design & Innovation; Faculty Director, Doctor of Management Program

Satish Nambisan, PhD  
(Syracuse University)  
Nancy and Joseph Keithley Professorship of Technology Management; Professor, Design & Innovation

Casey E. Newmeyer, PhD  
(University of Pittsburgh)  
Assistant Professor, Design & Innovation

Rakesh Niraj, PhD  
(Washington University in St. Louis)  
Associate Professor, Design & Innovation; Director of Undergraduate Marketing Programs

Simon Peck, PhD  
(University of Leeds)  
Associate Dean, MBA Programs; Associate Professor, Design & Innovation

Vasudevan Ramanujam, PhD  
(University of Pittsburgh)  
Associate Professor, Design & Innovation

N. Mohan Reddy, PhD  
(Case Western Reserve University)  
B. Charles Ames Professor of Management; Professor, Design & Innovation

Jagdip Singh, PhD  
(Texas Tech University)  
AT&T Professor of Marketing; Professor, Design & Innovation; Faculty Director, Business Analytics

Robert E. Widing II, PhD  
(The Ohio State University)  
Professor, Design & Innovation

Youngjin Yoo, PhD  
(University of Maryland)  
Elizabeth M. and William C. Treuhaft Professor of Entrepreneurship, Design & Innovation

### Economics Faculty

Mariana Carrera, PhD  
(University of California, Berkeley)  
Assistant Professor, Economics

David Clingingsmith, PhD  
(Harvard University)  
Associate Professor, Economics

Robin A. Dubin, PhD  
(Johns Hopkins University)  
Chair and Professor, Economics

Justin Gallagher, PhD  
(University of California, Berkeley)  
Assistant Professor, Economics

Jenny Hawkins, PhD  
(University of Arizona)  
Assistant Professor, Economics

Susan Helper, PhD  
(Harvard University)  
Frank Tracy Carlton Professor of Economics; Professor, Economics

Glenda Oskar, PhD  
(University of California, Berkeley)  
Visiting Assistant Professor

Silvia Prina, PhD  
(Boston University)  
Associate Professor, Economics

Scott A. Shane, PhD  
(University of Pennsylvania)  
A. Malachi Mixon III Professor of Entrepreneurial Studies; Professor, Economics

Roman Sheremeta, PhD  
(Purdue University)  
Assistant Professor, Economics

Daniel Shoag, PhD  
(Harvard University)  
Visiting Associate Professor, Economics

Mark Votruba, PhD  
(Princeton University)  
Associate Professor, Economics; Faculty Director, MSM-Healthcare
Weatherhead School of Management Courses

Operations Faculty
Stephen Brady, PhD
(Harvard University)
Assistant Professor, Operations

Ali Reza Kabirian, PhD
(Iowa State University)
Assistant Professor, Operations

Kamlesh Mathur, PhD
(Case Western Reserve University)
Chair and Professor, Operations; Faculty Director, Business Analytics

Jie Ning, PhD
(University of Michigan, Ann Arbor)
Assistant Professor, Operations

Daniel Solow, PhD
(Stanford University)
Professor, Operations

George Vairaktarakis, PhD
(University of Florida)
William E. Umstattd Professor of Industrial Economics; Professor, Operations

Qi Wu, PhD
(University of Texas, Austin)
Assistant Professor, Operations

Organizational Behavior Faculty
Diane Bergeron, PhD
(Columbia University)
Associate Professor, Organizational Behavior

Diana Bilimoria, PhD
(University of Michigan)
KeyBank Professor; Chair and Professor, Organizational Behavior

Richard E. Boyatzis, PhD
(Harvard University)
Distinguished University Professor; H.R. Horvitz Professor in Family Business; Professor, Organizational Behavior

Susan S. Case, PhD
(New York University at Buffalo)
Associate Professor, Organizational Behavior

Corinne A. Coen, PhD
(University of Michigan)
Associate Professor, Organizational Behavior

Harlow Cohen, PhD
(Case Western Reserve University)
Professor, Organizational Behavior; Faculty Director, MPOD Program

David L. Cooperider, PhD
(Case Western Reserve University)
Distinguished University Professor; Fairmount Santrol - David L. Cooperider Professor in Appreciative Inquiry; Professor, Organizational Behavior

Ronald Fry, PhD
(Massachusetts Institute of Technology)
Professor, Organizational Behavior

Chris Laszlo, PhD
(University of Paris)
Professor, Organizational Behavior; Faculty Executive Director and Faculty Director for Research and Outreach, Fowler Center;

Tracey Messer, PhD
(Case Western Reserve University)
Assistant Professor

Melvin L. Smith, PhD
(University of Pittsburgh)
Professor, Organizational Behavior; Faculty Director, Executive Education

John Paul Stephens, PhD
(University of Michigan)
Associate Professor, Organizational Behavior

Ellen Van Oosten, PhD
(Case Western Reserve University)
Assistant Professor, Organizational Behavior; Faculty Director, Executive Education

Weatherhead School of Management Courses

ACCT Courses

ACCT 101. Introduction to Financial Accounting. 3 Units.
Financial reports are the most significant means for an organization to communicate its management results to stockholders, creditors, and regulators. This course covers concepts, principles, and practices, including preparation and interpretation, of financial reports. The financial reporting system and basic internal controls for the balance sheet, income statement, and cash flow statements are discussed. A student may not receive credit for both ACCT 101 and ACCT 203. Offered as ACCT 203 and ACCT 403.

ACCT 102. Management Accounting. 3 Units.
This course focuses on management accounting as a supporting system, helping managers to run businesses and other organizations. The course builds on knowledge of microeconomics, organizational design and behavior, production, and logistics as a foundation to explore how management accounting provides information for management planning, control and decision activities. Prereq: ACCT 101 or requisite not met permission.

ACCT 203. Survey of Accounting. 3 Units.
The course covers the principle of financial and managerial accounting for non-management students, including the framework that underlies financial and management accounting and how accounting information should be used by: (1) parties external to the firm, i.e., stockholders, creditors and government, to evaluate the financial performance of an organization; and (2) internal management to fulfill the planning, control and performance evaluation functions. Enrollment is limited to students who are neither management nor accounting majors nor enrolled in the Weatherhead School of Management. This course may be substituted for ACCT 101. A student may not receive credit for both ACCT 101 and ACCT 203. This course cannot be substituted for ACCT 102 without a waiver from the chairman. Offered as ACCT 203 and ACCT 403.
ACCT 207. Excel Applications and Modeling. 3 Units.
Through this course, the student will gain an understanding of how to create accounting models and how to leverage Microsoft Excel as an important tool. ACCT 207 combines classroom, lab and project work to complete assignments leveraging Microsoft Excel. Prereq: ACCT 101 or ACCT 203.

ACCT 300. Corporate Reporting I. 3 Units.
ACCT 300 is the first course in the Corporate Reporting sequence. This course examines the basic financial statements (balance sheet, income statement, statement of cash flows), the asset side of the balance sheet (from cash to inventory), accrual versus cash accounting, revenue recognition, time value of money, and profitability analysis. Also, this course will highlight some of the differences between GAAP and IFRS relative to the topics covered. Prereq: ACCT 101 or ACCT 203. Coreq: ACCT 102 and ACCT 207.

ACCT 301. Corporate Reporting II. 3 Units.
This course is the second of a 3 course sequence and covers financial accounting theory, generally accepted accounting principles and reporting practices. Areas of focus include: property plant and equipment, liability determination, long-term debt, derivatives, leases, pensions and other postretirement benefits, and investments. International (IFRS) aspects also are considered. Prereq: ACCT 300.

ACCT 302. Corporate Reporting III. 3 Units.
ACCT 302 continues the Corporate Reporting sequence as the third and final course. This course covers many of the most complex areas of accounting. These areas include issues of accounting for income taxes, shareholders equity, share based compensation, accounting changes and errors, the statement of cash flows, governmental accounting and not for profit accounting and notes prepared using U.S. GAAP accrual accounting. Deep understanding of these topics is essential for the CPA exam and for professional practice. In addition, this course covers the differences between GAAP and IFRS related to the accounting content in the course. Prereq: ACCT 300.

ACCT 304. Advanced Financial Reporting. 3 Units.
This course covers partnerships, consolidations, foreign exchange, international aspects of accounting, accounting for state and local governments and not-for-profit organizations, segment reporting and interim reporting. Prereq: ACCT 301.

ACCT 305. Income Tax: Concepts, Skills, Planning. 3 Units.
This course addresses U.S. Federal Income Taxation concepts and applications. The subject matter includes topics applicable to individuals, partnerships and corporations and various other entities required to file income tax returns. In addition the subject matter addressed includes a variety of business, legal and taxation concepts and practices related to effective tax planning. The purpose of the course is to provide the student with the appropriate knowledge and skill levels to "speak the language of U.S. tax." Prereq: Sophomore Standing.

ACCT 306. Accounting Information Systems - Basic. 3 Units.
This course introduces the students to the major business cycles as they relate to Accounting Information Systems, including the revenue, procurement and conversion cycles. Additionally, students will be introduced to ERP systems and obtain hands-on experience using SAP’s Enterprise Resource Planning System. Prereq: ACCT 102 or ACCT 203.

ACCT 314. Attestation and Assurance Services. 3 Units.
This course covers the role of the auditor, the audit process, the public accounting profession, audit risk and materiality, fraud, audit methods and techniques, audit planning, internal control, the effects of information technology on the audit, auditing revenue, receivables and inventories, professional ethics, legal responsibilities, emerging assurance services, and recent developments in the auditing profession. Prereq: ACCT 301.

ACCT 360. Independent Study. 1 - 18 Units.

ACCT 401. Financial and Managerial Accountancy. 3 Units.
This course examines the underlying framework of financial and managerial accountancy, focusing on how financial information is used by: (1) parties external to the organization to evaluate financial performance, i.e., stockholders, creditors, and government agencies; and (2) internal management to plan, control, and evaluate the financial results of the organization. Prereq: Standard MBA, Cohort MBA - PT, or Cohort MBA - PT - Clev Clinic.

ACCT 401H. Accounting for Healthcare. 3 Units.
This course exposes MSM-Healthcare students to ways that accounting information helps managers monitor and improve the performance of organizations. After studying the nature and limitations of accounting information, we explore how financial, cost, tax, and regulatory accounting are used by various stakeholders. From this effort, students become comfortable evaluating accounting recognition, valuation, classification, and disclosure issues that arise in an executive’s career. Finally, we study how accounting is a feedback loop that enables managers to assess consequences of past decisions and think about what should be done going forward. Feedback loops, in turn, can give rise to observer effects and/or unpredictable outcomes. Course content contributes to achieving the program goal of strengthening a student’s ability to promote positive change in healthcare. Prereq: MSM Healthcare students only.

ACCT 403. Survey of Accounting. 3 Units.
The course covers the principle of financial and managerial accounting for non-management students, including the framework that underlies financial and management accounting and how accounting information should be used by: (1) parties external to the firm, i.e., stockholders, creditors and government, to evaluate the financial performance of an organization; and (2) internal management to fulfill the planning, control and performance evaluation functions. Enrollment is limited to students who are neither management nor accounting majors nor enrolled in the Weatherhead School of Management. This course may be substituted for ACCT 101. A student may not receive credit for both ACCT 101 and ACCT 203. This course cannot be substituted for ACCT 102 without an waiver from the chairman. Offered as ACCT 203 and ACCT 403.

ACCT 404. Advanced Financial Reporting. 3 Units.
ACCT 404 covers advanced financial reporting topics including financial statement consolidations, foreign currency translations and transactions, VIE’s, (variable interest entities), partnership accounting, derivatives, segment reporting, and interim financial statement reporting. As a graduate course, a master's level project or paper will be required. Prereq: ACCT 301.

ACCT 405. Advanced Federal Taxes. 3 Units.
Corporate income taxes, estate and gift tax, fiduciary income taxes, partnerships, and hybrid forms of organization are covered. Prereq: ACCT 305.
ACCT 406. Auditor's Role in AIS Accounting. 3 Units.
ACCT 406 is a three hour class in which the students will combine classroom and project work to learn to use Accounting Information Systems in the performance of business process and financial statement audits, and to audit the Accounting Information Systems themselves. Students will leverage tools like SAP's Enterprise Resource Planning system, spreadsheets, and data analytics software. Prereq: ACCT 207 and ACCT 306.

ACCT 414. Corporate Reporting and Analysis. 3 Units.
This course provides a basis for evaluation of traditional and proposed uses of report and information for decision making in investment, credit, and internal planning and control. Students are introduced to concepts and analytical techniques that can be used to critique and interpret the financial health of the organization. At a practical and theoretical level, the course integrates research in the areas of accounting, quantitative methods, and finance which has proved useful in the financial analysis of organizations. Prereq: ACCT 300 or ACCT 401, MBAC 502 or MBAP 402 or requisites not met permission of instructor.

ACCT 431. Tax Practice: Analysis, Planning and Communications. 3 Units.
This course concentrates on teaching the identification of key U.S. tax issues, the analysis of fundamental tax concepts and the underlying interpretation and application of tax law through the use of appropriate authoritative sources. Both oral and written communication will be utilized to present tax planning research results. Actual court cases will be used as the basis for simulating practical client scenarios. Prereq: ACCT 305.

ACCT 444. Advanced Auditing Theory and Practice. 3 Units.
This course examines auditing concepts and issues in depth. A special focus exists on audit evidence and how auditors make decisions. Some topic areas include ethics, analytical review, fraud, and the role of technology. Prereq: ACCT 314 or Requisites Not Met permission.

ACCT 480. Multi-Jurisdictional Taxation. 3 Units.
Multi-jurisdictional taxation is one of the most exciting and fastest growing areas of tax practice. This course examines the tax and business issues faced by businesses seeking to expand operations, both across state and local jurisdictions within the U.S. and across international boundaries. We consider the basic state sales, use, and income tax treatment of multi-state businesses; the U.S. tax treatment of businesses investing abroad; and the U.S. taxation of inbound foreign investment. A student will achieve a practical command of the tax issues, from an accountant’s perspective, which are raised by international and multi-state U.S. transactions and how the U.S. and State tax laws resolve those issues. Prereq: ACCT 305.

ACCT 495A. Advanced Accounting Seminar (Audit). 1 Unit.
This seminar provides an opportunity to consider specialized technical financial reporting and attestation services (audit) topics of importance in the rapidly changing environment of professional accountancy. The specific topic and scope of the coverage will be defined by the course instructor and will be consistent with the Master of Accountancy Financial Reporting and Attestation Services (Audit) concentration. The development of writing and communication skills and in-depth discussion are expected attributes of seminar activity. Prereq: ACCT 314 or Requisites Not Met permission.

ACCT 495T. Advanced Accounting Seminar (Tax). 1 Unit.
This seminar provides an opportunity to consider specialized technical taxation topics of importance in the rapidly changing environment of professional accountancy. The specific topic and scope of the coverage will be defined by the course instructor and will be consistent with the Master of Accountancy U.S. Taxation (Tax) concentration. The development of writing and communication skills and in-depth discussion are expected attributes of seminar activity. Prereq: ACCT 305 or Requisites Not Met permission.

ACCT 501. Special Problems and Topics. 0 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

ACCT 520. Advanced Accounting Theory. 3 Units.
This seminar studies contemporary issues in financial accounting theory and business reporting. Topics are considered from their historical development to contemporary circumstances. Academic and professional literatures are employed to gain a variety of perspectives on current matters. The development of communication skills, written and verbal, and use of support technology for presentations is emphasized throughout. Students are required to make several individual and team presentations, to conduct database and periodical research and to provide frequent written and oral research reports. Prereq: MAcc students only and ACCT 304. Prereq or Coreq: ACCT 404.

ACCT 540. Corporate Governance and Contemporary Accounting Policy. 3 Units.
The Sarbanes-Oxley Act (SOX), passed in the wake of a series of corporate accounting scandals including Enron and WorldCom, was designed to strengthen Corporate Governance processes for all US publicly traded companies with an aim of “protecting investors by improving the accuracy and reliability of corporate disclosures.” The contemporary implications of SOX for the accounting profession are immense. Students must understand these implications to successfully navigate the world of public company financial reporting. One implication is the role SOX gave to corporate board audit committees to oversee the independent auditors charged with auditing public company financial statements. This requires a fundamental understanding of corporate boards including why they exist and what are their more general responsibilities. Another implication is the establishment of the Public Company Accounting Oversight Board (PCAOB) to regulate the accounting profession. Thus, this seminar examines broad issues surrounding Corporate Governance including governance of public companies including investment companies, with strong contemporary connections to the accounting profession, including professional ethics, independence and quality control. Prereq: MAcc students only, ACCT 304, and ACCT 314. Prereq or Coreq: ACCT 404.

ACCT 601. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to Ph.D. candidates undertaking reading in a field of special interest.

ACCT 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.
BAFI Courses

BAFI 341. Money and Banking. 3 Units.
This course emphasizes the importance of financial markets, the nature and role of the financial system, and the linkages between these—money and banking—and the economy. Emphasis is placed on both theoretical and practical constructs, on major innovations and contemporary changes, and the closely intertwined condition of financial and economic systems with monetary and fiscal policy. Offered as BAFI 341 and ECON 341. Prereq: ECON 102 and ECON 103.

BAFI 342. Public Finance. 3 Units.
Government intervention is a pervasive feature of every modern economy. The goal of this course is to develop the economic tools for understanding and evaluating a wide range of government behaviors such as taxation and redistribution policy, the public provision of goods and services, and the regulation of private markets. ECON 342 begins by considering "market failures" that justify government intervention in a market economy. To respond to such failures, governments must raise revenues through taxation. Using the tools of microeconomic theory, we will develop a framework for thinking about the positive and normative effects of alternative forms of taxation. Particular attention will be paid to the individual income tax in the U.S., allowing students to understand the efficiency, distributional and behavioral implications of recent changes in the tax code. We will then turn to the expenditure side of the public sector. The economic principles used to evaluate public expenditures will be discussed and exemplified through the analysis of significant public programs. Of particular interest will be the effect of public programs on the incentives faced by workers and families. Offered as BAFI 342 and ECON 342. Prereq: ECON 102.

BAFI 355. Corporate Finance. 3 Units.
The basic goals of this course are to familiarize students with the concepts and tools used in financial management at both the corporate and personal levels. They include the notion of present value, securities valuation, risk and return analysis, and other financial analysis techniques. The concepts and techniques are, in turn, used to evaluate and make decisions regarding the firm's investments (capital budgeting) and the cost of capital. Prereq: Minimum sophomore standing; ACCT 101 or ACCT 203.

BAFI 356. Investments. 3 Units.
This course is about investing in securities. It provides a comprehensive introduction to security analysis and portfolio management. Investing is a rational decision-making process in which the investor seeks to select a package or portfolio of securities that meets a predetermined set of objectives. Descriptive, institutional and quantitative decision-making methods are arranged in a cohesive framework of analysis of interest to the informed investor. Topics include modern portfolio theory, the relation between risk and return, efficient markets, bonds, and options, among others. Prereq: BAFI 355.

BAFI 357. Financial Modeling, Analysis and Decision Making. 3 Units.
Firms try to create value. In their day-to-day operations, they are faced with numerous challenges: Should we accept trade credit or borrow? Will an acquisition create or destroy value? Should we introduce a new product line even if it cannibalizes an existing one? In each of these situations they try to quantify the impact on the value of their firm. The goal of this course is to develop your skills in financial modeling and valuation, so you can tackle issues like the ones described above. The course is designed to be "hands-on": You will learn to apply the theory and develop spreadsheet modeling skills through homework, case studies and a group project. By the end of the course you will have a good understanding of both the theory and practice of valuation, and possess a set of cutting-edge financial modeling skills. This course is designed for students who aspire to work in a regular company, a bank or a consulting firm in (i) corporate finance (including mergers and acquisitions); (ii) strategy; or (iii) equity and analysis. Prereq: BAFI 355.

BAFI 358. Intermediate Corporate Finance. 3 Units.
This is a rigorous second course in corporate finance (following BAFI 355) designed to lay the analytic foundation for careers in business. The objective is to strengthen students' theoretical and conceptual understanding of several important topics in finance, and to develop their problem-solving skills. Topics covered include economic cash flows and valuation, Long term financial planning and ratios analysis, Growth and external financing, Short term financial planning and Working capital management, Managerial options and valuation, Derivatives, Agency cost and asymmetric information, Capital structure and payout policy. Prereq: BAFI 355

BAFI 359. Cases in Finance. 3 Units.
This course applies the case study method applied to a variety of business situations that teaches students to think on their feet, develop presentation skills and hone business judgment. The objective of the course is to strengthen students' conceptual understanding and problem-solving skills. It is intended to complement the two course sequence in corporate finance (BAFI 355 and BAFI 358) by applying these concepts to real world problems. Topics covered include cash flow estimation and corporate valuation, financial planning and ratio analysis, financing using internal and external sources, capital budgeting and managerial options, capital structure, payout policy, financial strategy, public equity analysis (including initial public offerings), mergers and acquisitions and leveraged buyouts. The course envisages an extensive use of case studies and simulation exercises. Prereq: BAFI 355.

BAFI 360. Independent Study. 1 - 18 Units.
This course is offered for candidates undertaking reading in a field of special interest. Permission of department chair required.

BAFI 361. Applied Financial Analytics. 3 Units.
This course is developed based on the feedback received from employers who have hired BS Management (finance) graduates in the past and will likely do so in future. The goal is to enable students to use financial econometrics to effectively analyze financial data. The course will draw on theoretical aspects of BAFI 355 but focus on developing financial analytic skills. The applied nature of the course comes from the use of real, rather than theoretical, data. In other words, in a real-world fashion, through the use of statistical methods to analyze real data, the student can address practical questions of high relevance to the Finance industry. The scope of the data as well as the quantitative methods used in such analysis often requires familiarity with computational environments and statistical packages. As such, another goal of the course is to familiarize the student with at least one such environment. Prereq: BAFI 355 and STAT 207 or OPRE 207.
BAFI 372. International Finance. 3 Units.
This course deals with open-economy macroeconomics and international financial markets, covering open-economy national income analysis, international macroeconomic policy coordination, exchange rate determination, foreign portfolio investment, and global financial crises. Offered as BAFI 372 and ECON 372. Prereq: ECON 103.

BAFI 403. Financial Management. 3 Units.
The purpose of this course is to familiarize the student with the theory and application of additional models used in financial decision-making by corporations. Issues relating to efficient markets, dividend policy, capital structure, financing decisions, option pricing, leasing, and risk management are among the topics considered. In addition, special topics may include mergers and acquisitions, pension funds, and international financial management. Prereq: ACCT 401 or MBAC 502 or MBAP 402.

BAFI 404. Financial Modeling. 3 Units.
This is a course about financial modeling. It covers a range of topics in the field of financial economics. Each topic is chosen because it lends itself to financial modeling. The primary focus of the course is to relate the theory of finance to practical and usable spreadsheet models that will assist a financial manager with a firm's investment and financing decisions. Spreadsheet models have been the dominant vehicle for finance professionals to practice their trade. This course will utilize Excel and challenge the student to improve their finance and modeling skills. Students will improve their familiarity with financial data analysis through various exercises that incorporate completed models. In summary, the course is designed to increase your practical understanding of core concepts in finance, help you develop hands-on spreadsheet modeling skills, and strengthen your ability to perform financial data analysis within an Excel model. Prereq: MBAC 504 or MBAP 405.

BAFI 420. Health Finance. 3 Units.
Exploration of economic, medical, financial and payment factors in the U.S. healthcare system sets the framework for the study of decisions by providers, insurers, and purchasers in this course. The mix of students from various programs and professions allows wide discussion from multiple viewpoints. Offered as BAFI 420 and HSMC 420. Prereq: ACCT 401 or ACCT 401H and enrollment in a program other than MSM in Healthcare.

BAFI 427. Green Finance. 3 Units.
Natural systems and resources are being depleted, degraded, and impaired at a rapidly increasing pace. Yet there are very few businesses that are paying adequate attention to the adverse impact of such changes on their future as well as on their survival. How do these changes affect corporate risks? What financial challenges do they create? How can policy changes help move firms in the right direction? What innovative products and strategies can companies use to deal with these challenges? How can companies assess sustainability risk? How can these strategies add sustainable value to firms? These are just a sample of the questions that we will address in this course. This course on Green Finance will provide you with a unique opportunity to understand and explore such questions, especially as they pertain to the role of senior financial managers as well as other members of the senior management team of companies across different industries. It will expose you to cutting edge practices in the area of green finance, providing you with the thought leadership that is essential for success in today's competitive world.

BAFI 428. Financial Strategy and Value Creation. 3 Units.
The intersection between the theory of perfect markets and the reality of market imperfections provides the basis for the exploration of value creation in this course. Opportunities in both product and financial markets are explored using case studies to develop a framework for strategic financial decisions.

BAFI 429. Investment Management. 3 Units.
This course explores the characteristics of financial investments and markets and develops modern techniques of investment analysis and management. The goal is to help students develop a level of analytical skill and institutional knowledge sufficient to make sensible investment decisions. Topics include: an overview of stock, debt and derivative asset markets, practical applications of modern portfolio theory, equilibrium and arbitrage-based approaches to capital market pricing, the debate over market efficiency, the term structure of interest rates, bond portfolio management, and uses of derivative assets in investment portfolios. Prereq or Coreq: BAFI 403 or MBAC 504 or MBAP 405 or GMB 401A.

BAFI 430. Derivatives and Risk Management. 3 Units.
This course is intended to give students an understanding of options and futures markets both in theory and practice. The emphasis is on arbitrage and hedging. The course concentrates on listed common stock and index contracts as well as commodity markets. Various theories for trading strategies are studied. Prereq or Coreq: BAFI 403 or MBAC 504 or MBAP 405 or GMB 401A or student in the Accelerated Global MBA program.

BAFI 431. Fixed Income Markets and Their Derivatives. 3 Units.
This class is concerned with fixed income securities, interest rate risk management, and credit risk. Fixed income securities account for about two thirds of the market value of all outstanding securities, and hence this topic is important. The course covers the basic products of fixed income markets including treasury and LIBOR products, such as interest rate swaps. Risk management and hedging strategies are covered as well as selected topics in credit risk models and mortgage-backed securities. Prereq: BAFI 430.

BAFI 432. Corporate Risk Management. 3 Units.
This is a unique strategic risk management course aimed at participants who wish to enhance their understanding of the risks faced by corporate firms, both financial and non-financial, learn techniques to identify and measure these risks, and understand how derivatives and risk management solutions can be used to manage these risks, create value, and advance the strategic goals of the firm. The course is designed in a manner such that it would be of use to executives of all corporations, financial and nonfinancial, across all functional areas. Prereq: BAFI 403 or MBAP 405 or MBAC 504 or MBAC 505.

BAFI 433. Quantitative Risk Modeling. 3 Units.
This course is designed to help students learn quantitative models for estimating risk in various financial settings for different types of financial institutions (banks, hedge funds, and others). It is a very hands-on course where students will become familiar with several state-of-the-art quantitative risk models as well as their detailed implementation procedure in the real world. The course uses several in-class Excel exercises to illustrate the models as well as their practical implementation using real financial data. Offered as BAFI 433 and MSFI 433.
BAFI 440. Financial Decisions, Contracting & Value. 3 Units.
The firm is a nexus of contracts among its various stakeholders (managers, shareholders, debt holders etc.). In this course, we will examine how value is created, and how real world conflicts between the various stakeholders of a firm lead to deviations from “perfect world” solutions. For instance, you may have learned in basic corporate finance courses that it is optimal to invest in positive NPV projects. Real-world conflicts can make it sub-optimal for shareholders do so. We will examine such issues and ways to mitigate them. In particular, we will examine Valuation, Asymmetric Information, Agency Cost, Incentive Contracts and Performance Metrics, and, time permitting, also discuss Regulation, Reputation and the role of certifiers and the economic crises. The takeaway learnings from this course are: (a) Understanding how Value can be created or destroyed, (b) Measuring Value, (c) Understanding the links between capital structure and: asymmetric information, market reactions and signaling, agency and management incentives, taxes, shareholder-bondholder conflicts etc., (d) Understanding the links between payout policy and: informational content, market reaction, stock returns and signaling, clientele effects etc., and (e) Understanding the need for and the design of incentive mechanisms. Case studies will be used to reinforce learning. We will emphasize on links to real-world events.

BAFI 444. Entrepreneurial Finance. 3 Units.
The objective of this course is to introduce students to the issues of financial management and capital formation in new ventures. The course will address issues of estimation of cash requirements, development of pro forma financial plans, firm valuation and the process and tools used in raising debt and equity financing. Bootstrapping, angel investing, venture capital, strategic alliances and initial public offerings will be covered. The emphasis is on the entrepreneur and how he/she can assess financial needs and develop a sensible plan for acquiring financial resources in a manner that is consistent with their financial needs and other strategic goals. Offered as BAFI 444 and MSFI 444. Prereq: MBAC 504 or MBAP 405 or BAFI 402 or MSFI 403 or GMBA 401A or MEM students.

BAFI 450. Mergers and Acquisitions. 3 Units.
This course examines the economic rationale and motivation for the different merger and acquisition and recapitalization activities undertaken by firms and individuals in the U.S. market. Emphasis is on the comparable publicly traded proxy company, comparable “change of control” transaction, and discounted cash flow methods of valuing a firm. The class will also review the different types of debt and equity capital employed to fund mergers and acquisitions and recapitalizations, how senior lenders and equity investors structure their loans and/or investments, and how investors realize the gains through different exit strategies. The legal and tax ramifications of various forms of M&A activity are also discussed. The course gives the student an excellent understanding of the role that senior commercial banks, insurance companies, pension funds, LBO funds, investment banking firms, and venture/growth capital investors play in mergers and acquisitions and will strengthen the students’ ability to value a business enterprise. Prereq: BAFI 403 or MBAC 504 or MBAP 405 or GMBA 401A or student in the Accelerated Global MBA program.

BAFI 460. Investment Strategies. 3 Units.
This course provides a broad survey of some of the main strategies used by hedge funds today. Through exercises and projects, the hedge fund strategies will be presented using real data. Students will learn to use a methodology referred to as “back testing” in order to evaluate hedge fund strategies. The course will also cover institutional details related to short selling, liquidity, margin requirements, risk management, and performance measurement. Since hedge funds today use advanced modeling techniques, the course will require students to analyze and manipulate real data using mathematical modeling. The objective of the course is for students to gain practical knowledge about creating, back-testing, and implementing hedge fund trading strategies. Offered as BAFI 460 and MSFI 460. Prereq: BAFI 429 or MSFI 429.

BAFI 480. Global Banking & Capital Markets. 3 Units.
This course will expose students to Banking and Capital Market Structure, Practices, and Regulations in North America, Europe, as well as Asia. Students will learn about structure of the financial services industry in different parts of the world, the history and evolution of the regulatory frameworks in this industry, and its consequent impact on financial and economic development as well as risk. Several case studies are used to expose students to different issues and questions that arise in the day-to-day jobs of financial managers in this industry. Offered as BAFI 480 and MSFI 480. Prereq: MBAC 505 or MBAP 405 or BAFI 403 or MSFI 403 or GMBA 401A.

BAFI 492. Scientific Python Programming with Applications. 0 Unit.
Python is a popular programming language and is used by all sorts of companies. It has many advantages: it is free, easy to learn, fast to learn and very versatile. This course will teach you how to read, write and understand Python scripts. You will learn good coding conventions, and be introduced to relevant resources and tools. We will move past the basics of procedural programming and explore how we can use the Python built-in data structures such as lists, dictionaries, and tuples to perform increasingly complex data analysis and we will utilize many libraries to do advanced scientific analysis, as well as data structuring and data analysis. Offered as MSOR 492 and BAFI 492.

BAFI 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

BIOS Course
BIOS 447. Regulatory Affairs for the Biosciences. 1.5 Unit.
This mini-course introduces students to the Food and Drug Administration (FDA) and the laws and regulations it enforces. A scientific regulatory agency with far reaching enforcement authority, FDA is the most powerful consumer protection agency in the world. This course will familiarize students with FDA’s mission, philosophy and organizational structure, as well as policy and procedure it uses to ensure the safety and effectiveness of the food, drugs, biologics, cosmetics, medical devices and radiation-emitting products it regulates. Recommended preparation: Enrollment in the MEM Biomedical Entrepreneurship Track. Offered as BIOS 447, HSMC 447, and IIME 447.

BLAW Courses
BLAW 331. Legal Environment of Management. 3 Units.
This course is designed as a survey course in the area of basic business law. It covers the fundamental legal principles and laws that underlie any business decision. The major topics include: contracts, the Uniform Commercial Code (sales), torts, real and intellectual property, business organizations, Securities Regulation and Agency.
ECON 102. Principles of Microeconomics. 3 Units.
This course is an introduction to microeconomic theory, providing a foundation for future study in economics. In particular, it addresses how individuals and businesses make choices concerning the use of scarce resources, how prices and incomes are determined in competitive markets, and how market power affects the prices and quantities of goods available to society. We will also examine the impact of government intervention in the economy.

ECON 103. Principles of Macroeconomics. 3 Units.
While Microeconomics looks at individual consumers and firms, Macroeconomics looks at the economy as a whole. The focus of this class will be on the business cycle. Unemployment, inflation and national production all change with the business cycle. We will look at how these are measured, their past behavior and at theoretical models that attempt to explain this behavior. We will also look at the role of the Federal Government and the Federal Reserve Bank of the United States in managing the business cycle.

ECON 255. Economic History of the United States. 3 Units.
The growth of the American economy from the colonial period to the present. Competing explanations of economic growth; significant attention to the political and legal environment in which the U.S. economy developed; "lessons" of past experience for contemporary policy; some attention to inequality and the changing distribution of wealth and income. Offered as ECON 255 and HSTY 255.

ECON 307. Intermediate Macro Theory. 3 Units.
Macroeconomics studies aggregate indicators of the performance of an economy, most commonly measured in terms of GDP, unemployment rate and inflation rate. An important goal of macroeconomic researchers is to develop a model of an economy that is simple, yet powerful enough to explain the historical trends of these aggregate economic indicators. Needless to say, coming up with a good model has remained a very difficult task. So far, there is no single model that is good enough to coherently explain even the most prominent historical trends of aggregate economic indicators. But several models have been built, each offering insight into a certain aspect of the economy. Throughout the course model building is motivated by real world cases from the American economy. Prereq: ECON 102 and ECON 103.

ECON 308. Intermediate Micro Theory. 3 Units.
This course builds on ECON 102 to provide a deeper understanding of microeconomic theory, which forms a basis for much of economic analysis. The main focus of the class will be theoretical, in order to give you a solid foundation for future study in virtually any other field of economics. This includes the theory of how consumers decide what to consume and how firms decide when to stay in business, and how much to produce at what price. Note: a student cannot receive degree credit for both ECON 308 and ECON 309. Prereq: ECON 102 and (MATH 121 or MATH 125).

ECON 309. Intermediate Micro Theory: Calculus-Based. 3 Units.
This course builds on Economics 102 and provides a more in-depth analysis of the theory of the consumer, the theory of the firm, market equilibrium, market failure and government intervention in the market. We will use calculus to derive supply, demand and market equilibrium from first principles. You should come away from this course with a greater understanding of how consumers and firms make their decisions and how they interact in the market place. Note: a student cannot receive degree credit for both ECON 308 and ECON 309. Prereq: ECON 102 and (MATH 122 or MATH 126).

ECON 310. Marketing Analytics. 3 Units.
To appreciate, design, and implement data-based marketing studies for extracting valid and useful insights for managerial action that yield attractive ROI, five essential processes are emphasized: (a) making observations about customers, competitors, and markets, (b) recognizing, formulating, and refining meaningful problems as opportunities for managerial action, (c) developing and specifying testable models of marketing phenomenon, (d) designing and implementing research designs for valid data, and (e) rigorous analysis for uncovering and testing patterns and mechanisms from marketing data. Offered as MKMR 310 and ECON 310. Prereq: MKMR 201 and OPRE 207.

ECON 312. Entrepreneurial Finance - Undergraduate. 3 Units.
This course explores the financing and financial management of entrepreneurial new ventures. The course will focus on issues of financial management of new ventures (forecasting cash flows, cash flow management, valuation, capital structure) and the various financial methods and mechanisms available to entrepreneurs (bootstrapping, angel investors, venture capitalists, IPOs). Offered as ENTP 310 and ECON 312. Prereq or Coreq: ACCT 101 or ACCT 203 or consent of instructor.
ECON 326. Econometrics. 4 Units.
Econometrics is the application of statistics to empirical economic analysis. One way of testing the validity of economic theories is to gather data and apply statistical tests to see if the data support the theory. These data are usually gathered by observing actual economies, firms and consumers, rather than by performing experiments in a laboratory. Because economic analysts lack the precision and control of the laboratory, they must compensate by adjusting their statistical procedures. In this class, we will concentrate on regression analysis, which is the basic tool of the economic researcher. We will study the assumptions commonly made in the application of this technique, the consequences of violating these assumptions, and the corrections that can be made. Students will have a chance to formulate and test their own hypotheses using econometric software available for personal computers. Recommended preparation: One semester of statistics or consent of instructor. Prereq: ECON 102 and ECON 103 and (OPRE 207 or STAT 243 or STAT 312).

ECON 327. Advanced Econometrics. 3 Units.
This class builds on the foundations of applied regression analysis developed in ECON 326. The goal of the class is to equip students with the tools to conduct a causual analysis of a hypothesis in a variety of settings. Topics will include causality, panel and time series data, instrumental variables and quasi-experiments, semi- and non-parametric methods, and treatment evaluation. Offered as ECON 327 and ECON 427. Prereq: ECON 326.

ECON 328. Designing Experiments for Social Science, Policy, and Management. 3 Units.
Both economists and firms are increasingly relying on experiments to study the economic behavior of individuals and the effectiveness of policies in a wide range of settings. This course gives students the tools they need to design and critique experiments that answer a research or business question. A small part of the class will be devoted to important theoretical concepts in experimental design, such as treatments, factorial designs, randomization, internal and external validity, biases, and inference problems. The bulk will be devoted to learning about how these concepts come together by discussing exciting new experimental work on topics such as discrimination and identity, cooperation versus self-interest, and dishonesty and corruption. Prereq: ECON 102 and (OPRE 207, STAT 201, STAT 243, STAT 312, ANTH 319, or PSCL 282).

ECON 329. Game Theory: The Economics of Thinking Strategically. 3 Units.
The term "game theory" refers to the set of tools economists use to think about strategic interactions among small groups of individuals and firms. The primary purpose of this course is to introduce students to the basic concepts of game theory and its applications. The class will stress the use of game theory as a tool for building models of important economic phenomena. The class will also include a number of experiments designed to illustrate the game theoretic results, and to highlight how reality may depart from the theory. The course will stress the value of thinking strategically and provide students with a framework for thinking strategically in their everyday lives. Rather than approaching each strategic situation they encounter as a unique problem, students will be taught to recognize patterns in the situations they face and to generalize from specific experiences. A paper on an application of game theory will be required for graduate students. Offered as ECON 329 and ECON 429. Prereq: ECON 102.

ECON 330. Economic Behavior and Psychology. 3 Units.
This course is an introduction to Behavioral Economics, a growing field which incorporates insights from other disciplines—primarily psychology—into microeconomic models. We will cover fundamental aspects of decision-making, such as how people respond to risk, how people make trade-offs between short-term and long-term rewards, and the ways in which people aren’t as selfish as standard economic models suggest. We will cover novel economic models that can accommodate phenomena such as altruism, loss aversion, and self-control problems. We will discuss empirical applications of these concepts in areas ranging from personal finance and health to marketing and public policy. Prereq: ECON 102.

ECON 332. Economic Analysis of Labor Markets. 3 Units.
This course is about the economics of work and pay. We will take a comprehensive look at labor markets in the U.S. and other advanced countries and examine related social policy issues. This will include the effect of unions on wages, the underpinnings of the income distribution of the U.S., issues of poverty and welfare, discrimination and wage differential by gender and race, the relationship between work and family, education as a determinant of wages, and the way firms use wage and employment practices to motivate their employees to work productively. What makes labor economics special is that the commodity we examine is human labor, something that is central to the organization of our lives and the functioning of the economy. Labor economics thus applies the standard neoclassical model of demand, supply, and equilibrium to many areas that also have a profound human dimension. Prereq: ECON 102.

ECON 338. Law and Economics. 3 Units.
This course examines legal institutions and rules from an economic perspective. Students will learn when and how legal rules can be efficient. Topics will include property law (including intellectual property), tort (accidental) law, contracts, and crime. Offered as ECON 338 and ECON 438. Prereq: ECON 102.

ECON 341. Money and Banking. 3 Units.
This course emphasizes the importance of financial markets, the nature and role of the financial system, and the linkages between these—money and banking—and the economy. Emphasis is placed on both theoretical and practical constructs, on major innovations and contemporary changes, and the closely intertwined condition of financial and economic systems with monetary and fiscal policy. Offered as BAFI 341 and ECON 341.

ECON 342. Public Finance. 3 Units.
Government intervention is a pervasive feature of every modern economy. The goal of this course is to develop the economic tools for understanding and evaluating a wide range of government behaviors such as taxation and redistribution policy, the public provision of goods and services, and the regulation of private markets. ECON 342 begins by considering "market failures" that justify government intervention in a market economy. To respond to such failures, governments must raise revenues through taxation. Using the tools of microeconomic theory, we will develop a framework for thinking about the positive and normative effects of alternative forms of taxation. Particular attention will be paid to the individual income tax in the U.S., allowing students to understand the efficiency, distributional and behavioral implications of recent changes in the tax code. We will then turn to the expenditure side of the public sector. The economic principles used to evaluate public expenditures will be discussed and exemplified through the analysis of significant public programs. Of particular interest will be the effect of public programs on the incentives faced by workers and families. Offered as BAFI 342 and ECON 342. Prereq: ECON 102.
ECON 346. Economic Perspectives. 3 Units.
This course examines important contemporary and historical issues from an economic perspective. It enables students to think about the world "like an economist." Possible topics of current interest include the transformation of Eastern Europe, ethnic and racial strife, environmental policy and sustainable development, and professional sports.

ECON 364. Economic Analysis of Business Strategies. 3 Units.
This course examines how companies compete against each other and interact with customers in an effort to increase profits. Topics include: pricing strategies, product differentiation, advertising, R&D strategies, bundling and tie-ins, entry barriers, mergers and acquisitions, collusion and cartels, the dynamics of network industries (e.g. information technology), and technology adoption and diffusion. The course will take two complementary perspectives. First, we will consider the point of view of companies, and ask how different business strategies can affect competitive success. Second, we will consider the perspective of consumers and policymakers: we will ask whether different firm strategies enhance or reduce social welfare, and will explore different policy options to increase welfare (e.g. antitrust policies, patent systems). The first part of the course will utilize a range of basic economic tools. In the second part of the course, we will apply what was learned in the first part to real examples of firms and industries, including both business and legal cases. Prereq: ECON 102.

ECON 368. Environmental Economics. 3 Units.
Economic models and reasoning provide a valuable lens through which to view many of the most intractable and perplexing environmental problems. The objective of this class is to apply the tools of a typical introductory or intermediate microeconomics course to topics involving the natural environment. That is, we will view environmental topics from the perspective of an economist. Topics that will be covered in this class include: Market failure in the case of externalities and public goods provision, Management of renewable resources, Cost-effective pollution control, and Energy use and global climate change. Perhaps the most exciting part of this course is that we will take tools from the classroom and apply them to ongoing environmental questions. Lectures will include guest presentations from professionals who are actively working on environmental challenges. Offered as ECON 368 and ECON 468. Prereq: ECON 102.

ECON 369. Economics of Technological Innovation and Entrepreneurship. 3 Units.
This course is designed to help students identify, evaluate, and obtain control over technological opportunities so they may successfully control over technological opportunities so they may successfully understand the challenges of starting new companies. The course focuses on four themes: 1) the source, discovery and evaluation of technological opportunities; 2) the process of organizing a new firm to produce new technology that satisfies the needs of customers; 3) the acquisition of financial and human resources necessary to exploit technological opportunities; and 4) the development of mechanism to appreciate the returns from exploitation of technological opportunities. Prereq: ECON 102.

ECON 370. International Finance. 3 Units.
This course deals with open-economy macroeconomics and international financial markets, covering open-economy national income analysis, international macroeconomic policy coordination, exchange rate determination, foreign portfolio investment, and global financial crises. Offered as BAFI 372 and ECON 372. Prereq: ECON 103.

ECON 372. International Trade. 3 Units.
This course deals with international trade theories and policies, covering gains from and patterns of trade, immigration, foreign direct investment, protectionism, multilateral trade liberalization, regionalism and the costs and benefits of globalization within as well as among nations. Prereq: ECON 102.

ECON 374. Financial Regulation. 3 Units.
This course will provide students with an understanding of the economic underpinnings of financial regulation as it exists in the United States today. The course will highlight salient aspects of financial markets, such as asymmetric information and the chains of exposures linking financial market participants, that make financial regulation both necessary and yet problematic. Emphasis will be put on the difference between regulations on individual financial firms as compared with regulating for systemic financial stability. The course will be designed to: (1) provide enhanced understanding of financial markets to undergraduate students who have already taken ECON/BAFI 341 (Money and Banking); (2) provide institutional insight to master’s level finance students; (3) illustrate the application of welfare analysis to financial regulation, and (4) teach all students to think critically about regulatory arbitrage and the dynamic evolution of regulated markets. Prereq: ECON 102, ECON 103 and (ECON 341 or BAFI 341).

ECON 375. Economics of Developing Countries. 3 Units.
This course focuses on international aspects of economic development. The term "developing country" is often defined as a country that exhibits low per capita income, high poverty level, low level of industrialization, or low life expectancy. In terms of size, the developing countries make up at least three-fourth of the world population. Why do we study those countries’ economies separately from the industrialized economies? In fact, low economic growth, high unemployment, or high poverty rates also exist in many developed countries. The differences lie not in the types of problems but in the causes of these problems. In addition, differences in the kind of institutions that prevail in developing countries also lead to different policy prescriptions. Among developing countries, differences in historical experience, cultural practices, political institutions and economic conditions are also enormous. Illustrations and explanations of those differences are provided from a wide range of developing countries. Prereq: ECON 102.

ECON 376. Inside the Financial Crisis. 3 Units.
This is a case study in the events surrounding the 2007 global financial crisis. The course will build from fundamental economic concepts into a comprehensive analysis of the elements which led to the collapse and the contemporary policy debates about the recovery. The background for debate will come from an analysis of: Housing and housing finance, bank runs and Bear Sterns, mortgage backed securities and toxic asset purchases. The course will then examine major components of the Dodd-Frank Act and enable students to assess whether the act will address the causes of the 2007 crisis and more importantly establish the conditions to prevent a future crisis. Prereq: ECON 102 and ECON 103.

ECON 377. Topics in Monetary Policy. 3 Units.
The course will highlight developments taking place in the United States, but will also compare and contrast with developments in Japan, the United Kingdom, the European Central Bank, and other selected countries. Emphasis will be put on (1) how the financial crisis exposed weaknesses in the official oversight of financial systems, and the new roles being assigned to central banks to remedy these deficiencies; and (2) the extraordinary monetary policy responses of central banks in pursuit of economic stability during the Great Recession, and implications of these responses for the future conduct of monetary policy. Prereq: ECON 102 and ECON 103.
ECON 378. Health Care Economics. 3 Units.
Healthcare accounts for over one-sixth of the U.S. national economy and over one-eighth of its workforce, shares that have dramatically increased over the last 50 years. The rapid growth in healthcare spending has accompanied growing concerns about the quality and efficiency of U.S. healthcare delivery and persistent disparities in access to care. Are these concerns justified? If so, what can policymakers do - and what are they doing - to address them? The purpose of this course is to develop the analytical skills necessary for understanding how the U.S. health care sector operates, how it has evolved, the forces at work behind perceived deficiencies (in access, quality and cost control), and the expected impact of alternative policy proposals. These issues are addressed through the lens of microeconomic theory. Under this framework, outcomes result from the interaction of decisions made by participants in the healthcare economy (e.g. patients, providers, insurers, government), with those decisions governed by the preferences, incentives and resource constraints facing each decision-maker. This course should be of particular interest to students who envision future careers in healthcare delivery, healthcare management, pharmaceutical and device innovation, health insurance or public health, as well as other policy-oriented students seeking to understand the contentious issues in healthcare policymaking. Prereq: ECON 102.

ECON 386. Urban Economics. 3 Units.
Microeconomic theory as taught in principles (and even intermediate) does not usually take into account the fact that goods, people, and information must travel in order to interact. Rather, markets are implicitly modeled as if everyone and everything is at a single point in space. In the first part of the course, we will examine the implications of spatial location for economic analysis. In the second part of the class, we will use microeconomic tools to understand urban problems. Topics that we will cover include urban growth, suburbanization, land use, poverty, housing, local government, transportation, education, and crime. Prereq: ECON 102.

ECON 391. Advanced Topics and Writing in Economics. 3 Units.
This course is characterized by intense yet open-ended intellectual inquiry, guided by reading from primary and secondary sources, and will include extensive practice in written and oral communication. The focus will be on contemporary economic issues and scholarship, and assumes a high level of ability in undergraduate economics training. Specifically, this course provides an avenue for an intellectual discourse on some of the most challenging present day economic issues, and we will rigorously think and write about how economic concepts can be applied to virtually any topic, issue and event in the social world. Students will be challenged throughout the course to think and write like an economist and see the world through the economist's lens. Counts as SAGES Departmental Seminar. Prereq: (ECON 308 or ECON 309) and (ECON 326 or BAFI 361).

ECON 395. The Economy in the American Century. 3 Units.
This class provides an approved SAGES capstone experience for economics majors. It uses American economic history as an arena for a culminating application of the diverse knowledge and skills students have acquired during their undergraduate careers. The twentieth century American economy was shaped by a series of transformations that make our lives profoundly different from those lived by Americans in 1900. Attempting to understand these transformations has shaped the discipline of economics. Events and processes such as mass migration, the Great Depression, the growth of women’s participation in the workforce, and suburbanization generated questions that economists developed theories and bodies of empirical evidence to answer. Students will synthesize knowledge accumulated in their prior undergraduate study to tackle big questions posed by the history of the American economy during the 20th century. These questions cover the spectrum of economic life and scholarship, from finance and technology to human capital and gender. Students form teams to tackle an important question developed in consultation with the instructor. Each team will be responsible for educating the class on their research findings through researching and delivering a class-length presentation and preparing readings and exam questions. Students will produce an individual final paper related to their team's topic that expresses their own scholarly perspective and interest. Counts as SAGES Senior Capstone. Prereq: Junior or Senior standing.

ECON 397. Honors Research I. 3 Units.
All students admitted to the Honors Program will undertake an independent research project (Senior Thesis) under the guidance of a faculty member (Thesis Advisor). ECON 397 is used to define the topic, review relevant literature, formulate hypotheses, and collect appropriate data toward completing their research project. Students will have the responsibility of providing regular progress reports to their thesis advisor highlighting the work accomplished to date, the immediate challenges confronting them, and a plan to complete the project in the time remaining. Prereq: ECON 102, ECON 103, ECON 326 and ECON 308 or ECON 309; Junior standing and minimum GPA of 3.3 in ECON major and 3.0 overall.

ECON 398. Honors Research II. 3 Units.
This is the second course in a two course sequence to complete the Honors Research Program in Economics. Counts as SAGES Senior Capstone. Prereq: A grade of B or higher in ECON 397.

ECON 399. Individual Readings and Research. 1 - 6 Units.
Intensive examination of a topic selected by the students. Students must receive permission from the program administrator before the start of the term, and permissions will only be granted in cases where the students have a clear learning plan and objectives in using the independent readings/research option that cannot be met through available course offerings.

ECON 403. Economics for Management. 3 Units.
This course surveys the basic principles of micro and macroeconomics. Topics covered in microeconomics include supply and demand, the theory of production and costs, market structures and factor markets. Macroeconomics topics are the national incomes accounts, the determination of national income, employment and inflation, fiscal and monetary policies and international trade.
ECON 427. Advanced Econometrics. 3 Units.
This class builds on the foundations of applied regression analysis developed in ECON 326. The goal of the class is to equip students with the tools to conduct a causal analysis of a hypothesis in a variety of settings. Topics will include causality, panel and time series data, instrumental variables and quasi-experiments, semi- and non-parametric methods, and treatment evaluation. Offered as ECON 327 and ECON 427.

ECON 429. Game Theory: The Economics of Thinking Strategically. 3 Units.
The term “game theory” refers to the set of tools economists use to think about strategic interactions among small groups of individuals and firms. The primary purpose of this course is to introduce students to the basic concepts of game theory and its applications. The class will stress the use of game theory as a tool for building models of important economic phenomena. The class will also include a number of experiments designed to illustrate the game theoretic results, and to highlight how reality may depart from the theory. The course will stress the value of thinking strategically and provide students with a framework for thinking strategically in their everyday lives. Rather than approaching each strategic situation they encounter as a unique problem, students will be taught to recognize patterns in the situations they face and to generalize from specific experiences. A paper on an application of game theory will be required for graduate students. Offered as ECON 329 and ECON 429.

ECON 431. Economics of Negotiation and Conflict Resolution. 3 Units.
Students frequently enroll in a negotiation class with one thought in mind—negotiating a better job offer from an employer. They soon learn, however, that negotiation skills can do far more than improve a pay check. Negotiations occur everywhere: in marriages, in divorces, in small work teams, in large organizations, in getting a job, in losing a job, in deal making, in decision making, in board rooms, and in court rooms. The remarkable thing about negotiations is that, wherever they occur, they are governed by similar principles. The current wave of corporate restructuring makes the study of negotiations especially important for M.B.A.s. Mergers, acquisitions, downsizing and joint ventures call into question well established business and employment relationships. Navigating these choppy waters by building new relationships requires negotiation skills. The increased stress on quality and other hard-to-measure aspects of relationships with customers and suppliers makes the process of negotiation even more complex and subtle. For these reasons, negotiation classes have taken center stage in the study of management. Every major business school now offers classes in negotiation and these classes are overwhelming with students. Offered as ECON 431 and ORBH 413.

ECON 438. Law and Economics. 3 Units.
This course examines legal institutions and rules from an economic perspective. Students will learn when and how legal rules can be efficient. Topics will include property law (including intellectual property), tort (accidental) law, contracts, and crime. Offered as ECON 338 and ECON 438.

ECON 468. Environmental Economics. 3 Units.
Economic models and reasoning provide a valuable lens through which to view many of the most intractable and perplexing environmental problems. The objective of this class is to apply the tools of a typical introductory or intermediate microeconomics course to topics involving the natural environment. That is, we will view environmental topics from the perspective of an economist. Topics that will be covered in this class include: Market failure in the case of externalities and public goods provision, Management of renewable resources, Cost-effective pollution control, and Energy use and global climate change. Perhaps the most exciting part of this course is that we will take tools from the classroom and apply them to ongoing environmental questions. Lectures will include guest presentations from professionals who are actively working on environmental challenges. Offered as ECON 368 and ECON 468. Prereq: MBAC 512 or GMBA 403A.

ECON 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

EDMP Courses

EDMP 610. Culture and World Politics. 3 Units.
Religion, ethnicity, and nationalism have assumed major political significance in the post Cold-War and post-9/11 eras. The course examines ideas of political democracy and economic liberalism in relation to different cultural and religious ideas and explores relationships among social values, political structures, and economics. Prereq: Must be enrolled in the DM Program.

EDMP 611. Theory and Practice of Collective Action. 3 Units.
The ability of autonomous and interdependent parties to coordinate actions, or to act cooperatively, affects a wide range of organizational and social problems. This course addresses the theory and practice of collective action in local, national and global contexts. Case studies of collective action problems, such as environmental protection, community revitalization, and the mobilization of interest groups will be discussed. Prereq: Must be enrolled in the DM Program.

EDMP 613. Leading Change. 3 Units.
Change is an enigma and yet sustained, desirable change (SDC) drives adaptation, growth and life itself. In this course, we will continuously attempt to answer two questions: What is the process of sustained, desirable change? and What is the role of a leader? Concepts from complexity theory will be used, including understanding the multilevel nature of SDC at the individual, dyad, team, organization, community, country, and global levels. Intentional Change Theory (ICT) will be used as the organizing concept for the changes studied. Leadership and its development will be examined by studying a number of topics and applying them to three major case studies: (1) yourself; (2) practice coaching with compassion; and (3) a major change project. This course will explore questions, such as: Who are effective leaders? How do they think and act? What makes us want to follow them? How are leaders developed? What is the role of emotional and social intelligence? How does a leader’s mind, body, heart, and spirit affect their performance? For Doctor of Management Students.
EDMP 614. Business as an Evolving Complex System. 3 Units.
The goal of this course is to provide a foundation for understanding how business systems evolve, why the business systems in the major advanced countries have evolved differently over the last 100 years or so, and what the underlying driving forces are. The focus is on transformation rather than economic growth. The course examines the evolution of business systems as a result of technological and organizational change. It deals with the role of history, culture and finance in generating business organizations in various countries. The course also studies the emergence of regional innovation systems and industry clusters, as well as how digitization and globalization are changing the "industrial logic." For Doctor of Management Students.

EDMP 616. Global Economic Systems and Issues. 3 Units.
This course provides a framework and analytical tools for understanding globalization and international economic relations in the context of the global political system. It analyzes the economic and political forces that are shaping global cooperation on economic matters, the role and impact of international economic institutions such as the World Bank, the International Monetary Fund, and the World Trade Organization, and evolving forms of regional governance, such as the European Union. It covers national and international policies and development and the causes and cures of international financial crises. The course revolves around concepts of efficiency, equality, power, and institutions in the making of public policy towards globalization of communications and transportation. Prereq: EDMP 665.

EDMP 617. Technology and Social System Design. 3 Units.
Managers are designers who shape the social and technical world we inhabit. This course explores the process of design and asks how managers can become better designers and interventionists who anticipate and evaluate the social, economic, and political consequences of existing and emerging products, processes, and organizational forms. For Doctor of Management Students.

EDMP 638. Qualitative Inquiry I. 3 Units.
This course explores ways to conceptualize an object of study and facilitates formulation of students’ conceptual work and production of research reports at the end of the first year of the program. The course conveys how to generate research ideas by critically reviewing literature and developing ideas that contribute to a problem or issue of interest by working with theory and extending previous research. The practicality of conducting certain kinds of research is evaluated and length, intensity and ethical constraints of different research efforts are examined. Each student produces a report communicating and supporting a conceptualization of the phenomenon of interest involving independent, mediating and dependent variables. The paper defines a problem of practice, presents, both visually and in narrative form, concepts shaped by field experience and prior writing that promote understanding of the problem, and includes a research proposal describing sample, data collection and data analysis. Prereq: EDMP 665.

EDMP 640. Social Ethics: Contemporary Issues. 3 Units.
The course draws upon intellectual ancestors and current thinkers in moral philosophy and ethics to assist each student in identifying, analyzing, and discussing social and ethical questions pertaining to the definition and purpose of contemporary life, the need for moral coherence, and the meaning of life in a global society. The unifying theme of the course is Tolstoy’s question, “How then shall we live?” The course does not seek to provide answers to the great questions of life. Rather, it tries to expand each student’s capacity to grapple with such questions. Prereq: Must be enrolled in the DM Program.

EDMP 641. Qualitative Inquiry II. 3 Units.
This course guides the student in conducting the qualitative research project that was proposed in EDMP 638. Fieldwork and initial analysis is conducted during the summer when data based on semi-structure interviews is collected and analysis begins using inductive coding techniques. A summer residency is held in mid-June to assess progress as final data collection and analysis continues. The aim of the fall semester is to prepare a formal research report on that project, which will be submitted to an academic research conference. The final report includes a revision of one’s conceptual model, integrating new understandings and literature arising from the data collection and analysis. Prereq: EDMP 638.

EDMP 642. Directed Studies Seminar. 0 - 9 Units.
At different times during the Program, EDM students register for Directed Studies courses. The purpose of these courses is to recognize the work the students are doing to conduct and present their individualized research at a high quality level. Activities conducted under the Directed Studies courses are dedicated to the collection of qualitative or quantitative data and the preparation of research reports. Prereq: Must be enrolled in DM program or PhD in Management: Designing Sustainable Systems track.

EDMP 643. Measuring Business Behaviors and Structures. 3 Units.
This course aims to develop the basic foundations and skills for designing and executing generalizable studies. It focuses on building competence in model building, construct measurement, research design, data collection methodologies, and application of analytical software commonly involved in quantitative inquiry. Covered topics include framing research questions, reliability and validity of measurement, quasi-experimental research design, and fieldwork for data collection. Classes are designed to balance between the theory and practice of quantitative research design, and will be linked to the participant’s own research projects. Prereq: EDMP 641.

EDMP 644. Integration of Qualitative and Quantitative Inquiry. 3 Units.
Using the mixed method research toolkit developed in previous courses, this course focuses on critically analyzing selected pieces of published applied and policy research to develop a critical appreciation of issues and debates that have wide applicability and relevance. In particular, it offers students ways to integrate and triangulate using a mixed method approach, different forms of evidence, and related evidence. In addition, this course addresses common method choice and justification issues and related challenges of validity and theory formulation that typically arise during the students’ execution of a series of individual research projects. Application of critical analysis and appreciation approach in justifying mixed methods designs to the student’s own research work is encouraged and supported by sharing and discussing common research and methodology themes and problems. Prereq: Must be enrolled in the DM Program.

EDMP 646. Advanced Analytical Methods for Generalizing Research. 3 Units.
This course addresses advanced topics in regression and structural equation modeling such as latent growth curve models, partial least squares, logit models, tests for various types of invariance, multiple-group analysis, multilevel analysis, and analyzing qualitative/categorical data. These analytical methods are intended to enhance the student’s toolkit as to facilitate a strong bridge to the academic literature and the application to specific data based problems that arise in applied managerial research. For Doctor of Management Students.
EDMP 648. Causal Analysis of Business Problems I. 3 Units.
Model Building & Validation I introduces fundamental concepts in theory-based model building and validation. In this course students will develop, explore, refine and validate a range of models appropriate for addressing their problem of practice including classification models, process models, variance models, and articulating nomological networks. In particular, the course will focus on effective conceptualizations of causation, control, mediation, and moderation. Further, foundational statistical techniques such as tests of assumptions of the data, exploratory factor analysis, and regression and path analysis will be introduced. Prereq: Must be enrolled in the DM Program.

EDMP 649. Causal Analysis of Business Problems II. 3 Units.
Building upon the first course in Model Building & Validation, this course will guide students through the theoretically-grounded variance models that are required for testing through structural equation modeling (SEM) in the quantitative portion of their research. Fundamental concepts in model testing will be reinforced using path analysis, and will include a deeper exploration of moderation by addressing topics such as moderated mediation and interaction effects. Beyond the analysis the course will emphasize precise and accurate formulation of theoretical models and associated reasoning, as well as careful interpretation of findings. The class will also delve into testing of data assumptions and prepare students for the model testing portion of their capstone assignments. Prereq: Must be enrolled in the DM Program.

EDMP 664. Knowledge Dissemination to Influence Managerial Practice. 3 Units.
The aim of this course is twofold. First, it supports students organizing and writing their DM thesis overview or their PhD thesis proposal. Also discussed are ways to organize and communicate in scientific genres, their aims and their generic properties. Secondly, students become acquainted with scientific communication and publishing. Effective reviewing, criteria for judging articles and theses, management of review processes, and how to communicate and respond to reviews are topics discussed. The course also addresses publication strategies and ways of managing and communicating scientific and managerial knowledge to different stakeholders. Prereq: Must be enrolled in the DM Program.

EDMP 665. Introduction to Research Inquiry. 3 Units.
This course begins participants’ three-year research experience. Energized by one’s personal passion and commitment to the topic, we seek for the work to be accomplished at a level that makes it worthy of widespread dissemination and influence as engaged scholars. The goal in this course is to prepare students to develop their minds as scholars by understanding the world of research, develop a research identity by identifying one’s research domain; learn to read academic literature and write in a scholarly style; work with academic literature to identify and digest concepts and theories that inform research on that problem; begin to develop a conceptual model that abstracts how the world may be functioning in that problem domain and points to a research question that can guide the next stage of the research. The final deliverable for this course is to present the research topic with substantiation for its significance, relevance and timeliness in the management field. This would include the research question(s); the literature review; and proposed qualitative methodology and analytical approach(es). For Doctor of Management Students.

EDMP 672. Flourishing Enterprise: Creating Sustainable Value for Business and World Benefit. 3 Units.
This course is designed to galvanize new visions of business and society, as well as organizational leadership. The course is born of a conviction that the future of human society and the natural world is intimately linked to the future of the world economy, business enterprises, and management education. The course presentations, books, dialogues, and interview projects are organized around three themes: (1) the state of the world and the economics possibilities of our time, (2) the business case for understanding business as an agent of world benefit—how business performance can profit from current and future advances in sustainable design and social entrepreneurship; and (3) tools for becoming a change leader—including the methods of Appreciative Inquiry and new insights about “strength-based” change emerging from the science of human strengths. The overarching aim is to provide a powerful introduction to the many facets of sustainable value creation as a complete managerial approach. Prereq: Must be enrolled in the DM Program.

EDMP 673. Understanding, Designing, Managing Complex Systems. 3 Units.
The purpose of this course is to provide a perspective on systems thinking and complex systems and aid PhD students in expanding the ideas in their research on systems, systems models, and complex systems. The work of the course will develop with increasingly difficult books on the subject of complex systems, a major case study in health care, and individual applications of the concepts to their potential research model and methods. Prereq: Must be enrolled in the DM Program.

EDMP 677. Designing Sustainable Systems. 3 Units.
Students in teams will recognize and work in practice on a managerial problem that involves dimensions of sustainability and design. They will develop a set of solutions to the problem by generating alternative models and intervention strategies to address the problem. The project results in a short presentation and written communication of the solution in a form of a poster or prototype. The course will also include presentations of intervention and action research approaches and issues of inquiry validation and theory development. Prereq: Must be enrolled in the DM Program.

EDMP 678. Effectiveness of Institutional, Individual and Organizational Decision Making. 3 Units.
This course introduces students to research on individual judgment and decision making. Drawing insights from research in economics, political science, psychology, management, and sociology, behavioral decision making and judgment is the study of how-why-when people make decisions. Sessions introduce and explore the discipline. Along with a historical review of the literature, the general topics of emotion, experience, self control, and motivation are introduced. Behavioral finance is a topic specifically used as the lens through which individual, group, and firm decision making and judgment are analyzed. Designed to expose the student to a number of academic theories which may be incorporated into their second year paper, this course will also allow the student to experience a deeper dive into the particulars of academic literature including research design, literature reviews, discussion and dissemination, etc. This course will employ an integrated learning format. Lectures, group projects, written assignments, etc. will be used throughout this semester. Prereq: Must be enrolled in the DM Program.
EDMP 680. Conflict & Cooperation in the Global Arena. 3 Units.
The global arena is described by some as a realm of perpetual conflict. Others argue that given the right institutions and incentives, international actors can find ways to achieve cooperation, peace and increased global prosperity. Still others suggest that the international political and economic arena is "what you make of it"—emphasizing the role of norms, identities and ideas in shaping international outcomes. This course will examine both theoretical and policy perspectives regarding the question of international conflict and cooperation, with a specific emphasis on drawing on insights from collective action theory and international relations scholarship. Prereq: Must be enrolled in the DM Program.

Program participants who have not successfully completed their Applied Research Projects before the start of the fall semester following their third year of enrollment in the E.D.M. Program will have seven years from the date of their initial matriculation into the Program to complete degree requirements. If their work continues beyond the normal 54 credit hours of designed courses, they will register for Applied Research Project Continuation. Continuation credits may also be used for students enrolling in the Program after August 2000, who have not completed their required course work and research requirements within the Program’s required 54 semester credit hours. Prereq: EDMP 665.

EMBA Courses
EMBA 417. TEAMS. 0 Unit.
This course enables the formation of E.M.B.A. study groups and classroom learning environment by introducing participants to their adult learning styles, models of group decision-making, theories of team development and rules of engagement for effective learning teams. Prereq: E.M.B.A. students only.

EMBA 430. Health Informatics, Analytics & Decision Making. 2.5 Units.
Increasingly in today's healthcare environment, those aspiring to succeed in leadership positions are expected to know and do more than their primary discipline traditionally required. They are also expected to transform their organizations - whether they are departments or IDS’s - to a higher state of quality, effectiveness, efficiency and competitiveness. To meet this expectation they must be able to harness the interrelated power of information, analytics and decision support to plan, evaluate, improve, and control their organization. This course is for executives in health care delivery, health planning, regulatory, or accrediting organizations who will be involved with, be responsible for, or oversee: The use and/or management of health or organizational information, and analytic and decision processes; The improvement / innovation of their organization’s operations and decision processes; and/or The design, acquisition, implementation, and/or evaluation of health information technologies (HIT). The course is intended to develop competence and confidence in the participant’s ability to understand and manage the complex information, analytics and decision environment. Prereq: E.M.B.A. candidates only.

EMBA 436. Accounting for Business Executives. 2.5 Units.
This course is an introduction to financial and managerial accounting, rather than a course in introductory accounting. This course is designed for the business professional and is intended to prepare the student to use the information prepared by accountants. It will not dwell in detail on the technical aspects of accounting or bookkeeping. In addition, this course is designed to help the student become an effective user of cost information, from the perspective of parties internal to the firm. This aspect of accounting is a compilation of techniques rather than a set of rules. Since the information is for private use, the goal is to create the most meaningful and useful data for use by managers. Assignments will be designed to develop the student’s ability to analyze and interpret accounting data and to more effectively utilize accounting data in day to day business decisions. Finally, this course is intended to strengthen abilities to identify problems and opportunities, to search out and analyze desired information leading to a well-reasoned conclusion, and to perform sensitivity analysis around that conclusion, using financial information. Prereq: E.M.B.A. candidates only.

EMBA 437. Economic Analysis for Managers. 2.5 Units.
This course, which is limited to students in the Executive M.B.A. program, explores the basic elements of the economic system which the executive needs to know in order to understand how the firm interacts with the system and how economic factors affect decision making. Prereq: E.M.B.A. candidates only.

EMBA 438A. Business Statistics and Quantitative Analysis. 1.25 Unit.
In this course, students study the use of modern quantitative and business statistics to support the executive decision-making process. With the help of computer software, the models examined assist in describing and analyzing problems and suggesting possible managerial actions. The techniques discussed include tools for decision making under uncertainty including regression analysis. This course is part of a two (2) course sequence. Prereq: E.M.B.A. candidates only.

EMBA 438B. Business Statistics and Quantitative Analysis. 1.25 Unit.
In this course, students study the use of modern quantitative and business statistics to support the executive decision-making process. With the help of computer software, the models examined assist in describing and analyzing problems and suggesting possible managerial actions. The techniques discussed include tools for decision making under uncertainty including regression analysis. This course is part of a two (2) course sequence. Prereq: EMBA 438A

EMBA 439. Corporate Finance. 2.5 Units.
The central organizing principle of this course is to familiarize the class with the basics of valuation. This first course in finance introduces the tools and methods employed in valuation of projects and corporate securities. Valuation involves the determination of (i) cash flows of the firm, project or financial assets and (ii) the discount rates that are used to compute the present values of the cash flows. Asset pricing models provide the underpinnings for the development of the discount rates. The material is synthesized in capital budgeting exercises which are cost-benefit analyses of capital project cash flows to evaluate whether they are value enhancing. Prereq: E.M.B.A. candidates only.
EMBA 441. Leading Change: Self. 2.5 Units.
The primary objective of Leading Change: Self is to learn a method for assessing your knowledge, abilities, values, and interests relevant to leadership and executive management so that you will be able to develop and implement a plan for enhancing your leadership and executive capability throughout your career and life. The enabling objectives are: (a) To systematically identify your current and desired capability (i.e., knowledge, abilities, values, and interests); (b) To develop an individualized learning agenda and plan for the next 3-5 years; and (c) To explore techniques to assist others in doing the same. This course will explore questions, such as: Who are effective leaders? How are they different than managers? How do they think and act? What makes us want to follow them? How are leaders developed? How can people help others become effective leaders? What type of leader do I want to be? And, what can I do to become that type of leader? Prereq: E.M.B.A. candidates only.

EMBA 441A. Leading Change: Self. 2 Units.
The primary objective of Leading Change: Self is to learn a method for assessing your knowledge, abilities, values, and interests relevant to leadership and executive management so that you will be able to develop and implement a plan for enhancing your leadership and executive capability throughout your career and life. The enabling objectives are: (a) To systematically identify your current and desired capability (i.e., knowledge, abilities, values, and interests); (b) To develop an individualized learning agenda and plan for the next 3-5 years; and (c) To explore techniques to assist others in doing the same. This course will explore questions, such as: Who are effective leaders? How are they different than managers? How do they think and act? What makes us want to follow them? How are leaders developed? How can people help others become effective leaders? What type of leader do I want to be? And, what can I do to become that type of leader? This course is part of a two (2) course sequence. Prereq: E.M.B.A. candidates only.

EMBA 441B. Leading Change: Self. 1 Unit.
The primary objective of Leading Change: Self is to learn a method for assessing your knowledge, abilities, values, and interests relevant to leadership and executive management so that you will be able to develop and implement a plan for enhancing your leadership and executive capability throughout your career and life. The enabling objectives are: (a) To systematically identify your current and desired capability (i.e., knowledge, abilities, values, and interests); (b) To develop an individualized learning agenda and plan for the next 3-5 years; and (c) To explore techniques to assist others in doing the same. This course will explore questions, such as: Who are effective leaders? How are they different than managers? How do they think and act? What makes us want to follow them? How are leaders developed? How can people help others become effective leaders? What type of leader do I want to be? And, what can I do to become that type of leader? The course will take place over two semesters. This course is part of a two (2) course sequence. Prereq: EMBA 441A.

EMBA 442. Innovation. 2.5 Units.
Organizations are under continuous pressure to be efficient and productive in order to generate (often short-term) profit. At the same time they must innovate to remain competitive in the long-term. Innovation involves the generation, development, and delivery of new products, processes, or businesses. Intrapreneurs are those who can successfully bring new ideas to fruition in established organizations. Innovation in the context of an established organization requires that intrapreneurs fundamentally understand the dynamics of innovation and innovation management. This course introduces fundamental concepts associated with innovation in the context of an established organization. Prereq: E.M.B.A. candidates only.

EMBA 443. Supply Chain Management. 2.5 Units.
Operations managers, ranging from supervisors to vice presidents, are concerned with the production of goods and services. More specifically, they are responsible for designing, running, controlling and improving the systems that accomplish production. This course is a broad-spectrum course with emphasis on techniques and information that are helpful to the practice of management in general and at any level. We will discuss commonly occurring application problems such as process analysis, inventory control, quality management, just-in-time concepts, etc. The field of operations management was originally concerned with manufacturing systems. But many of the same ideas apply, and the same trade-offs are present, in service organizations like health care, insurance, hotel-management, airlines and government related operations. Several manufacturing and non-manufacturing environments will be discussed explicitly, and the emphasis will be on the fundamentals of the operations function in an organization. Also we will explore the interface of operations management with other functional areas such as marketing, finance, accounting, etc. Prereq: E.M.B.A. candidates only.
EMBA 446. Managing Risk and Real Options. 2.5 Units.
The course seeks to help corporate managers understand how financial
design can be used to manage risk and seize opportunities. In the
Finance course, you concentrated almost exclusively on the firm’s capital
expenditure decision. You studied in great detail the discounted cash
flow model, NPV, how you get your cash flows, and how you discount
according to risk. Now we move to the other side of the balance sheet to
look at how the firm can finance these expenditures. The first part of this
class provides the basic building blocks of financial engineering which
begins with call and put options. The course focuses on using derivatives
(calls and puts) to change a firm’s risk profile with respect to equity,
interest rate, foreign exchange, credit, and commodity risks. We look at
capital structure decisions and securitization issues and discuss what it
means to create optimal structures. Almost immediately we will tie this to
our financial crisis and obtain an appreciation for financial designs that
could be setup so as to enhance firm value, mitigate systemic risks, or
accomplish specific sustainable goals in a global economy. The second
part of the class is geared towards real options and its relationship to
strategic planning. In competitive markets, no one expects to formulate
detailed long-term plan and follow it mindlessly. As soon as we start
down the path, we begin learning about business conditions, competitors’
actions, and so forth and we need to respond flexibly to what we learn.
Unfortunately, the financial tool most widely relied on to estimate the
value of strategy, DCF, assumes that we follow a predetermined plan,
regardless of how events unfold. A better approach to valuation would
incorporate both the uncertainty inherent in business and the active
decision making required for strategy to succeed. Prereq: E.M.B.A.
candidates only.

EMBA 449. Contemporary Issues in Management. 2.5 Units.
This course is intended to address the contemporary issues in
management to be decided by faculty and student interest. With the
current global economic crisis, this year the course will focus on
International Finance and Economics. In subsequent years, the topics
will evolve as the global business climate changes. Prereq: E.M.B.A.
candidates only.

EMBA 450. Managerial Marketing. 2.5 Units.
This course is designed with three overarching objectives. The first is an
emphasis on decision making in a broad range of market contexts. The
second objective builds on the notion that decision making is dynamic;
that is, market situations demand not just one good decision but a series
of them as a situation unfolds (providing new and varied information
for each subsequent decision). Integrating concepts from a number of
the courses that you are taking concurrently into decision-making about
markets is a final objective. Prereq: E.M.B.A. candidates only.

EMBA 451. Business Model Design. 2.5 Units.
In most companies the process of designing business models is an ad
hoc process and in my opinion an inefficient process. In this course you
will learn a systematic but iterative process to do this. We will expose
you to some broad categories of business models and internalize the
basic logic of how to make money in each of these categories. The first
step is to recognize which of these categories is most applicable to your
business. The second step is to customize these broad patterns to the
specifics of the business at hand. This seems easy because everything is
in English and there are no hard formulas to figure out. However, unless
you discipline yourself to systematically go through a structured process
(there are other equally valid processes than the ones you’ll be exposed
to) it is very easy to fall into the ad hoc trap. You will internalize this
process by applying it over a wide range of business situations that will
give you confidence in its applicability to any business opportunity. After
the completion of this course you should be quickly able to draw the
outline of a business model for any business opportunity that you’re
considering. Prereq: E.M.B.A. candidates only.

EMBA 458. Healthcare Financial Management. 2.5 Units.
This course will consider basic financial concepts, techniques, and
strategies for institutions and companies in the U.S. health care delivery
system. Note that this may differ from the influences one would find in
different country since the payment system and ownership structures
vary widely around the world. These basics include relevant factors
in the economic, medical, and financial environment that shape an
intelligent financial decision. Therefore, although the course is directed
towards financial management decisions in health delivery organizations,
it may also be useful for those who supply the industry (equipment,
drugs and services), purchase services from it (employers, third party
administrators, health plans) or finance these (insurance, banking,
investors). Public policy and the structure of the industry also play an
important role in the course. However, the general approach is from the
point of view of a decision-maker in a health care organizational setting
dealing with issues with important economic or financial dimensions.
Prereq: E.M.B.A. candidates only.

EMBA 459. Health Economics and Strategy. 2.5 Units.
The central goal of this course is for students to master essential
economic concepts and their application to critical issues in the U.S.
healthcare economy. After taking this course, students should be able
to: 1. Understand basic microeconomic theory as it applies to firm and
consumer behavior in healthcare and health insurance markets. 2.
Understand the role of market forces (including market failures) and
public policy in determining the price and allocation of medical services.
3. Understand the underlying causes of “changing market conditions”
and the challenges and opportunities they create for healthcare
organizations. 4. Converse fluently and accurately about the economic
forces at play in the healthcare economy. Prereq: E.M.B.A. candidates
only.

EMBA 464. Legal Environment. 2.5 Units.
This course provides a brief overview of the legal system that managers
face, with an emphasis on contracts, corporate law, property rights and
the modern regulatory apparatus of government. Contracts include
full coverage of the Uniform Commercial Code. Corporate law is the
capstone of the consideration of other forms of business organizations
such as partnerships. Regulatory areas include employment law and
environmental law. Property coverage includes modern struggles over
intellectual ownership claims (patents, copyrights, etc.). Prereq: E.M.B.A.
candidates only.
EMBA 472. Leading Change: The Organization. 2.5 Units.
Participants in this course will be challenged to enhance their leadership capacity by assessing and analyzing the knowledge, abilities, values and interests relevant to executives. The course will also explore the art of reading and understanding organizations in ways that help us imagine, design, and develop organization excellence. Prereq: E.M.B.A. candidates only.

EMBA 473. Leading Change: Teams. 2.5 Units.
Sustainability of effective leadership is necessary for adaptive, resilient organizations and for the health and functioning of the leader. Chronic stress results in diminished cognitive functioning, as well as poor health and a contagion of negative mood in organizations. The latest advances in social neuroscience and endocrinology will be used to develop an understanding how someone in a leadership position can renew themselves and mitigate the ravages of chronic stress. The short course will focus on how to coach others toward renewal and sustainability. Prereq: E.M.B.A. candidates only.

EMBA 475. International Tour. 3 Units.
This course is designed to present first-hand issues in international management. It accomplishes this by means of readings, a written assignment and, most importantly, an international trip designed to witness different management cultures, styles and environments for business in the international community. Faculty responsibility rests with the Faculty Director of the E.M.B.A. Program as well as a "Resident -Faculty" specific to each field trip. Such faculty are drawn from the Weatherhead community and vary by the design and destination of the trip. In addition, the course is staffed by an administrative assistant from the complement of Dively CMDR staff. Occasionally and where appropriate, there is also "in-tourist" assistance in some of our foreign locations Prereq: E.M.B.A. candidates only.

EMBA 476. Corporate Governance. 2.5 Units.
The course structure is grounded in the following themes: -The role of the board of directors; -The CEO relationship to the firm's principal stakeholders (shareholders, board of directors, employees, customers) and the CEO's responsibility to give back (time and money) to the community; -CEO role in developing and maintaining the organization's vision, values and corporate culture. Prereq: E.M.B.A. candidates only.

EMBA 477. Behavioral Economics. 1.5 Unit.
This class develops practical, actionable insights into how people make economic decisions in the real world. Standard economics proposes that decisions are motivated by a rational response to financial incentives and information. Behavioral economics expands the standard approach by incorporating and understanding the systematic biases and errors we make in interpreting information and making decisions. This expanded toolbox will help the student to improve their own decisions and to understand and motivate behavior in employees, customers, and others. Prereq: E.M.B.A. candidates only.

EMBA 478A. Leading Design in Organization. 1.25 Unit.
This course explores the ideas and methods of design as a new approach to management practices that is well suited to the changing environment that organizations face in contemporary culture and the emerging economic environment in the United States and abroad. It is a studio course as well as a seminar, because it is designed around a project that each student brings to the EMBA program, a project that is grounded in the issues and operations of the student's organization or in the kind of organization that the student wishes to explore. In addition to the yearlong project, the course will also include important readings in management and organizational literature that are relevant to the new direction of strategic thinking. Finally, the course will draw on the expertise of other faculty at the Weatherhead School of Management who will be called upon to share their practical expertise and theoretical knowledge in the development and execution of the student's management design project, whether in the area of vision and strategy, new product development of goods and services, operations, organizational design and configuration, or related topics. This is the first part of a two semester course. Prereq: E.M.B.A. candidates only.

EMBA 478B. Leading Design in Organizations. 1.25 Unit.
This course explores the ideas and methods of design as a new approach to management practices that is well suited to the changing environment that organizations face in contemporary culture and the emerging economic environment in the United States and abroad. It is a studio course as well as a seminar, because it is designed around a project that each student brings to the EMBA program, a project that is grounded in the issues and operations of the student's organization or in the kind of organization that the student wishes to explore. In addition to the yearlong project, the course will also include important readings in management and organizational literature that are relevant to the new direction of strategic thinking. Finally, the course will draw on the expertise of other faculty at the Weatherhead School of Management who will be called upon to share their practical expertise and theoretical knowledge in the development and execution of the student's management design project, whether in the area of vision and strategy, new product development of goods and services, operations, organizational design and configuration, or related topics. This is the second part of a two semester course. Prereq: E.M.B.A. candidates only.

EMBA 479. Leading Change: Society. 2.5 Units.
This course explores a proposition: that business, the motor of our society has the opportunity to be a new creative force on the planet, a force that could contribute to the well being of many. Our exploration and search is for "business as an agent of world benefit" and the questions are many: what does it look like, where is it happening, what are the market, societal and leadership enablers, and what are the results? Prereq: E.M.B.A. candidates only.

ENTP Courses

ENTP 301. Entrepreneurial Strategy. 3 Units.
This course is designed to show students how to identify potential business opportunities, determine what constitutes a good business model, and to strategically implement a business proposal. Topics of focus include an overview of the entrepreneurial process, determinants of venture success in high tech and other business environments, and strategies for industry entry and venture growth. Prereq: ACCT 101 or ACCT 203. Coreq: At least sophomore standing.
ENTP 310. Entrepreneurial Finance - Undergraduate. 3 Units.
This course explores the financing and financial management of entrepreneurial new ventures. The course will focus on issues of financial management of new ventures (forecasting cash flows, cash flow management, valuation, capital structure) and the various financial methods and mechanisms available to entrepreneurs (bootstrapping, angel investors, venture capitalists, IPOs). Offered as ENTP 310 and ECON 312. Prereq or Coreq: ACCT 101 or ACCT 203 or consent of instructor.

ENTP 311. Entrepreneurship and Wealth Creation. 3 Units.
This course explores all aspects of the creation of a new venture from idea through startup, growth, and beyond. Students will learn how to evaluate opportunities, develop strategies, create a business plan and acquire financing for a new venture. In this course students will develop a business plan for a new venture.

ENTP 428. Entrepreneurship and Innovation. 3 Units.
In all companies, new and old, large and small, innovation and entrepreneurship are important ways economic value is created. Whether a person wants to found their own company or work in an existing one, and whether one wants to run a business or simply work in one, it is difficult to go through one's career without needing to engage in innovation or entrepreneurship. The purpose of this course is to equip students to think about how to manage innovation and entrepreneurship. The course will provide frameworks and tools for understanding four important dimensions of innovation and entrepreneurship: (1) identifying and evaluating opportunities for the new products, processes, ways of organizing, materials, and markets; (2) assessing the needs of customers for new products and services and developing products and services that fulfill those needs; (3) creating strategies to financially benefit from investing in innovation and entrepreneurship; and (4) designing groups and organizations to be innovative and entrepreneurial.

ENTP 501. Special Problems and Topics. 1 - 18 Units.

HSMC Courses

HSMC 404. Managing People and Organizations. 3 Units.
Examines the behavioral sciences relevant to the effective management of people and the effective design of human resources systems, structure and policies. Topics include leadership, change management, motivation and pay systems, team dynamics, staffing, decision making, organizational communications, employee participation, performance appraisal, conflict management, negotiation, work design, organizational design, and organizations culture. A variety of methods, including experiential and interactive learning methods, are used to study these topics. Prereq; MSM Healthcare Students only.

HSMC 407. Managerial Marketing. 3 Units.
This course focuses on managing marketing as a process of creating value and mutually desirable exchanges of values. That is the foundation of a customer orientation and a central theme of market-driven management. Methods for strategic marketing planning, understanding buyer behavior, market analysis, segmentation and devising integrated marketing programs are introduced. Creating customer value and competitive advantage in worldwide markets is the central theme. Prereq: MSM Healthcare Students only.

HSMC 410. The American Healthcare Landscape and Statistics for Healthcare. 3 Units.
The goal of this course are (i) to establish a common understanding of the roles played by various institutions and players in the health care system, and (ii) to ensure competency in basic statistical tools utilized in empirical analyses. These are considered "foundational" topics for students in the MSM-Healthcare program, helping facilitate more effective and efficient delivery of material covered in subsequent courses. Prereq: Students in MSM-Healthcare or requisites not met permission.

HSMC 411. Identifying Design Opportunities. 3 Units.
Designing is giving form to an idea for a more desirable product, service, process or organization, and refining the idea into something that can be delivered reliably and efficiently. Good design integrates these evolving ideas with the day-to-day realities of a firms’ operations, systems, marketing, economics, finance and human resources. Designing is thus a unique managerial activity that brings together changing technologies, capabilities, relationships, activities and materials to shape an organization’s plans and strategies. It combines analysis and synthesis to create opportunities for improvement and means of attaining them. Viewed this way, designing is a core competence of a successful entrepreneur or innovative leader. Design analysis is the systematic review of the four orders of design found in every firm—namely, the firm’s communications, products, interactions and environments—and the creation of opportunities to increase firm value by improving each. Students will identify ill-defined, ill-structured problems within organizations. Such problems are ones for which there are no definitive formulations and for which the formulation chosen affects the solutions available. For such problems, there is no explicit way of knowing when you have reached a solution, and solutions cannot necessarily be considered correct or incorrect. But finding innovative solutions to such problems can provide unique opportunities to create exceptional value. A major outcome of the semester’s inquiry is a presentation of the design problem and proposed design solution. Prereq: MSM Healthcare Students only.

HSMC 412. Lean Services Operations. 3 Units.
The course will be delivered over four modules: 1) Service Process Blueprints, 2) Managing Capacity in Service Systems, 3) Mapping the Value Stream (current and future state), and 4) Inventory Management in Service Systems. The topics considered are viewed in the context of healthcare management, financial services, insurance firms, call centers, back-office operations, and other applications. Through these topics, the participants will be trained in tools that help them understand customers' expectations and needs and to identify service system characteristics that can meet these needs. We will learn how to identify errors in service and troubleshoot these problems by identifying the root causes of errors. Subsequently, we will discuss how one can modify the product or service design so as to prevent defects from occurring. Finally, we will establish performance metrics that help evaluate the effectiveness of the Lean system in place. These efforts will result to improved quality. This course is not oriented toward specialists in service management. Its goal is to introduce you to the environments and help you appreciate the problems that operations managers are confronted with. Then, we will typically discuss some system specifics and emphasize the principles and issues that play key role in their management. Offered as HSMC 412 and OPMT 412. Prereq: MSM Healthcare Students Only.
HSMC 420. Health Finance. 3 Units.
Exploration of economic, medical, financial, and payment factors in the U.S. healthcare system sets the framework for the study of decisions by providers, insurers, and purchasers in this course. The mix of students from various programs and professions allows wide discussion from multiple viewpoints. Offered as BAFI 420 and HSMC 420. Prereq: ACCT 401 or ACCT 401H and for MSM Healthcare students only.

HSMC 421. Health Economics and Strategy. 3 Units.
The purpose of this course is to develop the analytical skills necessary for understanding how the U.S. healthcare sector operates, how it has evolved, the forces at work behind perceived deficiencies (in quality and cost control), and the impact of alternative policy proposals. Special attention is being given to recent developments in the healthcare marketplace, and the strategic considerations they create for providers and insurers. These issues are addressed through the lens of microeconomic theory. Under this framework, outcomes result from the interaction of decisions made by participants in the healthcare economy (e.g., patients, providers, insurers, government), with those decisions governed by the preferences, incentives and resource constraints facing each decision-maker. Principles of microeconomics will be reviewed as necessary to ensure consistent understanding of basic concepts. The course is designed to appeal to a broad audience, particularly students interested in healthcare management, public health, medical innovation, health law, and public policymaking. Offered as HSMC 421 and MHP 421.

HSMC 425. Dialogues in Health Care Management. 3 Units.
Dialogues in Healthcare Management is designed to serve students in the MSM-Healthcare management program. The course seeks to educate students of the intricacies related to specific management challenges that arise in the context of healthcare delivery. This is accomplished through a process of facilitated dialogs with experienced healthcare management professionals. Drawing on the experiences and deep contextual knowledge of these professionals, the course provides students an opportunity to synthesize and apply their prior coursework to better understand the challenges and opportunities that managers face to improve organizational performance. Prereq: MSM Healthcare Students only.

HSMC 432. Health Care Information Systems. 3 Units.
This course covers concepts, techniques and technologies for providing information systems to enhance the effectiveness and efficiency of health care organizations. Offered as HSMC 432 and MHP 532.

HSMC 446. Models of Health Care Systems. 1.5 Unit.
This course is for professionals who will pursue their careers in, or associated with, the health care industry; and therefore, need to understand the structure, operations and decision influences in the health care delivery system. The course is intended to develop competence and confidence in the participant’s ability to understand and operate in the industry. The largest and, perhaps, the most complex in the United States. It is applicable to the private and public, profit and not-for-profit sectors. In this course students are introduced to: the different systems of care delivery; their organization and operations; their markets and the nature of the demand for their services; and the dynamics of their interaction among themselves and with other entities in the industry (e.g., payors/insurers, regulators and accreditors, technology and pharmaceutical suppliers). Offered as HSMC 446 and IIME 446.

HSMC 447. Regulatory Affairs for the Biosciences. 1.5 Unit.
This mini-course introduces students to the Food and Drug Administration (FDA) and the laws and regulations it enforces. A scientific regulatory agency with far reaching enforcement authority, FDA is the most powerful consumer protection agency in the world. This course will familiarize students with FDA’s mission, philosophy and organizational structure, as well as policy and procedure it uses to ensure the safety and effectiveness of the food, drugs, biologics, cosmetics, medical devices and radiation-emitting products it regulates. Recommended preparation: Enrollment in the MEM Biomedical Entrepreneurship Track. Offered as BIOS 447, HSMC 447, and IIME 447.

HSMC 456. Health Policy and Management Decisions. 3 Units.
This seminar course combines broad health care policy issue analysis with study of the implications for specific management decisions in organizations. This course is intended as an applied, practical course where the policy context is made relevant to the individual manager. Offered as HSMC 456 and MHP 456.

HSMC 457. Health Decision Making & Analytics. 3 Units.
The goals of this course are to: (1) introduce the sources of data healthcare that managers can exploit to improve decision-making in their organizations; (2) examine health decision making styles, approaches and impediments; (3) provide a framework for medical informatics and how information technology can be exploited to pursue organizational goals; and (4) examine the analytic tools necessary for turning "raw data" into actionable information. The course is pragmatic, covering such issues as the current state and emerging trends in medical informatics (MI), information principles, decision models and analytics approaches, as well as the impact of emerging health legislation, information systems and processes on decisions and analytics.

HSMC 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

LHRP Courses

LHRP 360. Independent Study. 1 - 18 Units.
This course is offered for candidates undertaking reading or independent research in a field of special interest.

LHRP 431. Negotiations for Managers. 3 Units.
The aim of this course is to enhance individual as well as organizational performance and competitive advantage through "principled negotiation", "win-win bargaining", and collaborative as opposed to competitive approaches to team problem solving. The context crosses all types of business, government and non-governmental organizations. Concepts, strategies, and models of negotiation are drawn from social psychology, economics, labor relations, and legal literature. Students will also be introduced to mediation (both as mediators and negotiators); to the complex art of advocacy and to the latest alternative dispute resolution (ADR) techniques. There is heavy reliance on simulations and role play to enhance student understanding of key course concepts. Although immediate skill enhancement through practice is a goal, students understanding of key concepts will enable them to continuously improve their insights and skills long after the course is concluded. There is no prerequisite for the course.

LHRP 501. Special Problems and Topics. 5 - 18 Units.
This course is offered, with permission, to students undertaking individual reading or research projects in a field of special interest.

LHRP 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.
MBAC Courses

MBAC 504. Corporate Finance. 3 Units.
This is a MBA core finance course. In this course, students are introduced to the basics of corporate finance, including the objectives of and the decisions made by corporate financial managers. Topics covered include time value of money, stock and bond valuation, cost of capital and risk and return, investment decision rules, cash flows and free cash flows, cash flow projections and planning, working capital management and short-term financing, capital budgeting, capital structure, dividend policy, efficient markets, and macroeconomic/industry analysis and valuation. The course envisages extensive use of spreadsheets, case studies, data analysis, and an intensive workshop. The course envisages extensive use of spreadsheets as well as an intensive workshop involving data analysis. Prereq: Full-time MBA program only.

MBAC 506. Marketing Management. 3 Units.
MBAC 506 (Marketing Management) and MBAC 507 (Operations and Supply Chain Management) are an integrated presentation of the process of marketing, operations and supply chain management. Thus, they must be taken in numerical sequence or concurrently. Through lecture, discussion, cases and/or simulations you will learn theory and practice of how firms develop processes to understand, create and deliver “triple bottom line” value (i.e., economic, social and environmental) to business and/or consumer markets. In systems theory these continual-input-transformation-output stages comprise value chains. Specifically in this course, we will introduce you to and help you to practice the ways managers think about and employ information, processes, tools and skills in order to 1. understand and target value from the customer’s perspective, 2. build marketing programs that attract, retain satisfied customers, and 3. evaluate brand equity based on customer lifetime value to the firm. Throughout both courses (see MBAC 507 for its specific content) we will address the integrated process of managing ongoing long-term relationships with customers, distribution partners and suppliers to assure long-term customer satisfaction and achievement of the organization’s economic, social and environmental goals. Prereq: Full-time MBA program only.

MBAC 507. Operations and Supply Chain Management. 3 Units.
MBAC 506 (Marketing and Supply Chain Management) and MBAC 507 (Operations and Supply Chain Management) are an integrated presentation of the process of marketing, operations and supply chain management. Thus, they must be taken in numerical sequence or concurrently. Through lecture, discussion, cases and/or simulations you will learn theory and practice of how firms develop processes to understand, create and deliver “triple bottom line” value (i.e., economic, social and environmental) to business and/or consumer markets. In systems theory these continual-input-transformation-output stages comprise value chains. Specifically, in this course, we will introduce you to, and help you to practice, the ways managers forecast demand, establish production processes for the product or service, manage inbound resource flows, and manage outbound distribution so the customer can get the product or service the way he or she wants (i.e., place, form, time and “experience” utility). Throughout both courses (see MBAC 506 for its specific content) we will address the integrated process of managing ongoing long-term relationships with customers, distribution partners and suppliers to assure long-term customer satisfaction and achievement of the organization’s economic, social and environmental goals. Prereq: Full-time MBA program only.

MBAC 508. Strategic Issues and Applications. 3 Units.
Strategic management deals fundamentally with the ways firms build and sustain superior competitive positions and profitability. Successful strategy design and implementation requires an understanding of a firm’s external environment, its internal resources and capabilities. It also requires an integrative view of the firm that spans functional areas such as operations, marketing and finance. Strategic analysis draws on a number of academic disciplines including economics, psychology, political and management science. Prereq: Full-time MBA program only.

MBAC 511. Statistics and Decision Modeling. 3 Units.
This course provides the foundations of statistical and operations research methodologies for managerial decision-making. Topics covered include making inferences for populations from sample data via (a) estimation with confidence intervals, (b) hypothesis tests, and (c) forecasting with simple and multiple regression. Decision modeling of organizational systems uses mathematical and computer models to provide a quantitative approach to analyzing and solving complex decision problems. This course includes an introduction to linear programming models and applications, queuing models, and simulation models. Prereq: Full-time MBA program only.

MBAC 512. Economics. 3 Units.
In this short class you will be introduced to the basics of modern microeconomic and macroeconomic thinking. Topics include consumers, firms, markets, the role of the government, information and public choice. This class will also focus on the economy as a whole: business cycle, statistics used to measure the economy, fiscal and monetary policy, international trade and development. Prereq: Full-time MBA program only.

MBAC 515. Leading People and Organizations. 3 Units.
Using the behavioral and social sciences as a basis, this course examines concepts relevant to the effective management of oneself, other people and organizations. In this course, students will learn and engage in a process of personal development and growth. This will include receiving feedback by engaging in a 360-feedback session, and receiving individual coaching that culminates in a personal vision statement and development plan. Students will also gain a better understanding of working in a team by learning about group and team dynamics. In order to be better managers and more effective leaders, they will also gain a better understanding of working in a team by learning about group and team dynamics. In order to be better managers and more effective leaders, they will also study various aspects of organizational life such as culture; motivation and reward systems; power, politics and influence; and social capital and social networks. A variety of methods, including self-assessments, experiential and interactive activities, case studies, and other types of media are used to study these topics. Students are encouraged to reflect on their experiences throughout the course. Prereq: Full-time MBA program only.
MBAC 517. Management Perspectives and Dialogues. 3 Units.
This course serves as a vehicle to exercise critical thinking and integration skills. While much is learned by attending to the various functions of a business, effective management requires that you be able to integrate these to better understand the whole (organization, supply chain, market, industry, etc.). The course addresses that objective in three ways. First, we will bring in teams of senior managers for you to engage in dialogue about issues they have recently addressed, expect to address in the near future and how they function as leaders of their organizations. Next, are several modules that explore a couple of particular perspectives on management—-that managers are designers and that businesses play a critical role in shaping a sustainable world. These are viewed as lenses for integrating the skills you are developing in the functional courses. Finally, we will have sessions in which you will practice thinking on your feet about how to approach business problems and situations. These are structured to help you in job interviews and to help you stand out in your early days in new work environment. The goal of this course is pragmatic. You can help by actively engaging with us in a dialogue about which elements work in helping you achieve these objectives and which do not. Prereq: Full-time MBA program only.

MBAC 520A. Design and Sustainability. 3 Units.
In the fall semester (MBAC 520A - Design & Sustainability, a 3 credit hour course) students are introduced to sustainability which creates a foundational platform featuring key models and managerial tools for the building sustainable value and "turning the social and global issues of our day into business opportunities. In the spring semester (MBAC 520B - Design Thinking in Management, a 3 credit hour course) students are introduced to Design which is giving form to an idea to conceive of a more desirable product, service, process or organization and refining the idea into something that can be delivered reliably and efficiently. Good design integrates these evolving ideas with the day-to-day realities of a firm's operations, systems, marketing, economics, finance and human resources. Designing is thus a unique managerial activity that brings together changing technologies, capabilities, relationships, activities and materials to shape an organization's plans and strategies. It combines analysis and synthesis in ways that are integrative and inventive, and through it managers create opportunities and means of attaining them. Prereq: Full-time MBA program only.

MBAC 520B. Design Thinking in Management. 3 Units.
Design Thinking in Management is a 3 credit hour course. In the fall semester (MBAC 520A - Design & Sustainability, a 3 credit hour course) students are introduced to sustainability which creates a foundational platform featuring key models and managerial tools for the building sustainable value and "turning the social and global issues of our day into business opportunities. In the spring semester (MBAC 520B - Design Thinking in Management) students are introduced to Design which is giving form to an idea to conceive of a more desirable product, service, process or organization and refining the idea into something that can be delivered reliably and efficiently. Good design integrates these evolving ideas with the day-to-day realities of a firm's operations, systems, marketing, economics, finance and human resources. Designing is thus a unique managerial activity that brings together changing technologies, capabilities, relationships, activities and materials to shape an organization's plans and strategies. It combines analysis and synthesis in ways that are integrative and inventive, and through it managers create opportunities and means of attaining them. Prereq: Full-time MBA program only.

MBAP Courses

MBAP 401. Leadership Assessment and Development. 3 Units.
This course is designed to increase competitive attractiveness in the marketplace and maximize the added value of the M.B.A. program. The objective of the course is to have students learn a method for assessing and developing in themselves the knowledge and abilities relevant to management throughout their careers. This is accomplished by helping students develop an individualized learning plan to enhance their level of knowledge in 11 fields and 22 abilities. Students engage in a number of assessment activities, then receive feedback and interpret it. This occurs in the context of an Executive Action Team (i.e., students and a facilitator) in which students help each other assess their current capability and future development needs. This course is limited to students in the Part-time Cohort M.B.A. program. Prereq: This course is for students in the Part-time Cohort MBA Program or Cleveland Clinic Part-time Cohort MBA Program only.

MBAP 403. Statistics and Decision Modeling. 3 Units.
This course provides the foundations of statistical and operations research methodologies for managerial decision-making. Business statistics focuses on statistical thinking as one of the fundamentals of effective management. Topics covered include sampling and the normal distribution, making inferences from data via confidence intervals and hypothesis tests, and analyzing relationships between samples. Decision modeling of organizational systems uses mathematical and computer models to provide a quantitative perspective on identifying, analyzing and solving complex decision problems. This course includes an introduction to linear programming models and applications, simulation techniques in decision-making, and project management. Prereq: This course is for students in the Part-time Cohort MBA Program or Cleveland Clinic Part-time Cohort MBA Program.

MBAP 404. Managing People and Organizations. 3 Units.
Examines the behavioral sciences relevant to the effective management of people and the effective design of human resources system, structure and policies. Topics include leadership, change management, motivation and pay systems, team dynamics, staffing, decision making, organizational communications, employee participation, performance appraisal, conflict management, negotiation, work design, organizational design, and organizations culture. A variety of methods, including experiential and interactive learning methods, are used to study these topics. Prereq: This course is for students in the Part-time Cohort MBA Program or MSM Healthcare program only.

MBAP 405. Financial Management I. 3 Units.
This is a Corporate Finance course that deals with investment theory and financial value. The course materials cover discounted cash flows, bond and stock valuation, capital budgeting, applications of real options in investment analysis, asset's risk and return, cost of capital, market efficiency and capital structure. The tools, problem solving techniques, and ways of thinking that you develop in this course have broad applicability to all areas of business. They also form the basis for sensible personal decisions in the areas of investments, borrowing, and financial planning. Prereq: This course is for students in the Part-time Cohort MBA Program or Cleveland Clinic Part-time Cohort MBA Program.
MBAP 406. Economics for Managers. 3 Units.
This course surveys the basic principles of micro and macroeconomics. Topics covered in microeconomics include supply and demand, the theory of production and costs, market structures and factor markets. Macroeconomics topics are the national incomes accounts, the determination of national income, employment and inflation, fiscal and monetary policies and international trade. Prereq: This course is for students in the Part-time Cohort MBA Program or Cleveland Clinic Part-time Cohort MBA Program only.

MBAP 407. Managerial Marketing. 3 Units.
This course focuses on managing marketing as a process of creating value and mutually desirable exchanges of values. That is the foundation of a customer orientation and a central theme of market-driven management. Methods for strategic marketing planning, understanding buyer behavior, market analysis, segmentation and devising integrated marketing programs are introduced. Creating customer value and competitive advantage in worldwide markets is the central theme. Prereq: This course is for students in the Part-time Cohort MBA Program, Cleveland Clinic Part-time Cohort MBA Program or MSM in Healthcare only.

MBAP 408. Operations Management. 3 Units.
Operations management deals with the design of products and processes, the acquisition of resources, the conversion of inputs to outputs, and the distribution of goods and services. It is central to a firm’s ability to compete effectively. As global competition in both goods and services increases, the management of operations is becoming more and more important. This course provides a broad overview of the managerial issues associated with production and delivery of goods and services. It includes the use of quantitative modeling using computers as a central methodology. Prereq: This course is for students in the Part-time Cohort MBA Program or MSM in Healthcare only.

MBAP 409. Sustainability and Social Entrepreneurship. 3 Units.
This course creates a foundational platform featuring key models and managerial tools for building sustainable value and “turning the social and global issues of our day into business opportunities.” Case studies of leading mainstream companies are used to analyze how business value is created for a range of social and environmental initiatives. Students will look at sustainability business strategies that reduce risks, drive down costs, create new revenue streams, serve new markets, and position companies to take advantage of changing societal expectations. Environmental issues such as climate change are covered along with social issues such as global poverty. Students acquire the competencies required to make effective business decisions based on integrating sustainability into the core of a company’s value added activities. Prereq: This course is for students in the Part-time Cohort MBA Program or Cleveland Clinic Part-time Cohort MBA Program only.

MBAP 410. Strategic Issues and Applications. 3 Units.
This course wraps up the M.B.A. core by providing an integrative experience of applying the full range of managerial skills addressed throughout the core in a comprehensive case exercise. Students develop, document, and present comprehensive, implementable strategic and tactical actions programs in groups. Prereq: This course is for students in the Part-time Cohort MBA Program or Cleveland Clinic Part-time Cohort MBA Program only.

MBAP 411. Identifying Design Opportunities. 3 Units.
Designing is giving form to an idea for a more desirable product, service, process or organization, and refining the idea into something that can be delivered reliably and efficiently. Good design integrates these evolving ideas with the day-to-day realities of a firm’s operations, systems, marketing, economics, finance and human resources. Designing is thus a unique managerial activity that brings together changing technologies, capabilities, relationships, activities and materials to shape an organization’s plans and strategies. It combines analysis and synthesis to create opportunities for improvement and means of attaining them. Viewed this way, designing is a core competence of a successful entrepreneur or innovative leader. Design analysis is the systematic review of the four orders of design found in every firm—namely, the firm’s communications, products, interactions and environments—and the creation of opportunities to increase firm value by improving each. Students will identify ill-defined, ill-structured problems within organizations. Such problems are ones for which there are no definitive formulations and for which the formulation chosen affects the solutions available. For such problems, there is no explicit way of knowing when you have reached a solution, and solutions cannot necessarily be considered correct or incorrect. But finding innovative solutions to such problems can provide unique opportunities to create exceptional value. A major outcome of the semester’s inquiry is a presentation of the design problem and proposed design solution. Prereq: This course is for students in the Part-time Cohort MBA Program or MSM in Healthcare only.

MGAB Course

MGAB 501. Study Abroad. 1 - 15 Units.
Place holder for students studying abroad, to be replaced with actual course work taken at Exchange location once course work is completed and a transcript is sent to CWRU.

MGMT Courses

MGMT 1. Supervised Professional Practicum - Semester 1. 0 Unit.
A professional practicum is a workplace experience, the primary goal of which is the intellectual, personal and professional growth of the student. It occurs under the sponsorship or supervision of a mentor in the workplace who is committed to seeing that it is an educational as well as a work venture. It requires skills appropriate to the student’s year in college and provides students with new skills, insights and experiences that are transferable back to the academic setting and/or to a future position in the workplace. (Only available to declared Weatherhead Accounting or Management majors.) Prereq: Junior standing or higher.

MGMT 2. Supervised Professional Practicum - Semester 2. 0 Unit.
A professional practicum is a workplace experience, the primary goal of which is the intellectual, personal and professional growth of the student. It occurs under the sponsorship or supervision of a mentor in the workplace who is committed to seeing that it is an educational as well as a work venture. It requires skills appropriate to the student’s year in college and provides students with new skills, insights and experiences that are transferable back to the academic setting and/or to a future position in the workplace. (Only available to declared Weatherhead Accounting or Management majors.) Prereq: Junior standing.
MGMT 201. Contemporary Business and Communication. 3 Units.
This course is designed to survey business topics, issues, and practices. Students will be introduced to each of the functional areas of business, including accounting, finance, marketing, operations, business intelligence, and human resources management. The course is designed to help students appreciate the interrelationship of these business functions and, more generally, the role and context of business in society. Other topics considered include: the economic and legal environment of business, the globalization of markets, workforce diversity, leadership and entrepreneurship. To convey course content, lectures, in-class discussions, exercises, simulations, and guest speakers are used. Weekly discussions and a high level of student interaction amplify on class materials and concepts by focusing on contemporary issues of actual businesses.

MGMT 315. International Management Institute. 3 Units.
The course provides undergraduate students with a unique overseas visitation, language orientation, and management subject experiences during periods such as Spring Break, or during interims immediately following the end of the semester. Opportunities for diverse cultural and language experiences which result from the institute are added benefits of these programs.

MGMT 360. Special Topics and Issues in Management. 1 - 9 Units.
This course option is available to qualified students who are undertaking special projects in a management related field.

MGMT 395. Advanced Seminar. 1 Unit.
This seminar, for undergraduate students with junior class standing or above, provides an opportunity to consider topics of importance in the community of ideas and activities related to the professional and managerial world. The development of writing and communication skills and in-depth discussion are expected attributes of seminar activity. The topic and scope of the coverage will be defined by the course instructor as consistent with the seminar approach to learning of the University. Counts as SAGES Departmental Seminar. Prereq: Declared ACCT or MGMT Major and At Least Junior Standing.

MGMT 397. Undergraduate Research Project. 3 - 6 Units.
This course provides a supervisory structure for students completing a capstone research project in the Weatherhead School of Management. Arrangements should be made by consultation with a faculty member selected and the Senior Capstone Committee of the School of Management. Open to all management and accounting majors and other qualified students with instructor approval. A written report, presentation to the faculty department most closely related to the student’s topic, and an approved public presentation are required. Counts as SAGES Senior Capstone.

MGMT 398. Action Learning. 6 Units.
This is an experiential course built around consulting projects in local organizations. Each project is focused on solving a business problem or pursuing a business opportunity. Each student will work in a team to analyze the current situation and identify related problems/opportunities, conduct research, analyze findings, creatively envision alternatives, and recommend an appropriate course of action and next steps. Throughout the semester students will receive instruction and coaching on the problem solving approach used in the course. Counts as SAGES Senior Capstone. Prereq: ACCT 102, BAFI 355 and MKMR 201, Senior Standing, and Declared ACCT or MGMT major.

MGMT 403. Leadership Assessment and Development. 3 Units.
This course is designed to increase competitive attractiveness in the marketplace and maximize the added value of the M.B.A. program. The objective of the course is to have students learn a method for assessing and developing in themselves the knowledge and abilities relevant to management throughout their careers. This is accomplished by helping students develop an individualized learning plan to enhance their level of knowledge in 11 fields and 22 abilities. Students engage in a number of assessment activities, then receive feedback and interpret it. This occurs in the context of an Executive Action Team (i.e., students and a facilitator) in which students help each other assess their current capability and future development needs. This course is limited to students in the M.B.A. program.

MGMT 413. Human Value in Organizations. 3 Units.
Examines the behavioral sciences relevant to the effective management of people and the effective design of human resources system, structure and policies. Topics include leadership, change management, motivation and pay systems, team dynamics, staffing, decision making, organizational communications, employee participation, performance appraisal, conflict management, negotiation, work design, organizational design, and organizations culture. A variety of methods, including experiential and interactive learning methods, are used to study these topics.

MGMT 418. Curricular Practical Training. 0 Unit.
This course is intended for graduate business students who wish to gain curricular practical training in support of career goals. The experience developed in an internship will complement academic experience gained in Weatherhead classes.

MGMT 440. Leadership Assessment and Development II. 0 Unit.
The exit assessment course (MGMT 440) is aimed at assessing how students’ career goals, values and abilities may have changed since the program began. The course meets for one mandatory half day seminar in the Spring Semester and carries o units of credit. In the MGMT 403 course, students were provided the tools and opportunities for self-assessment and career planning. In the very first semester, they completed several assessment instruments (LSI, POQ, 360-Feedback (ECI-U), ASI, My Values, Career Anchors and others). They had to identify their top values, set a career vision and created an individualized learning plan. The ultimate goal was to assure that their personal development and preparation was relevant to, and in alignment with, the emergent requirements of today’s business management careers. This course is specifically designed to identify if a student’s prior learning plan (completed in the MGMT 403 course) still fits with his/her current career reality and to also identify what has changed for him/her. The activities in the course will include: Viewing the current reality of today’s business environment; Revisiting their experience in the MBA program including any internships/jobs; Determining if a student’s values, vision and learning plan still fit; Retaking the 360-Feedback (Emotional Intelligence Competencies) to identify development of competencies; Identifying relevant areas of personal development; Committing to a refined learning plan and goals. Through a highly interactive and team based process, students will be able to reflect on their current reality, get feedback on your personal growth and discover what changes would enhance their professional career journey.
MGMT 458. International Institute. 3 Units.
The International Institute involves semester-long study of a particular region, followed by a class trip to an area within that region. The preparatory coursework varies depending on the region selected for that particular semester; however, it typically consists of research about cultural, financial, political, and economic topics. The trip consists of daily research meeting with organizations within the region being studied. Upon return, a summary exercise is required to complete the coursework. The class trip is a mandatory component of the course.

MGMT 460. Managing in a Global Economy. 3 Units.
Managers need new skills to enable them to manage effectively in what is increasingly a global economy. They need a deeper understanding of cultural differences and how these differences may influence communications with foreign employers, employees, customers, suppliers or partners. They need a better understanding of the economic and political mechanics of the world business system. They need to learn how to find out more about potential opportunities and threats that lie outside the United States. This course is designed to address these needs.

MGMT 464. Business Ethics. 3 Units.
This course is built around two core learning tracks. The first is extended analyses of case studies, which identifies ethical problems, diagnoses import, and develops strategic programs to address them. The second learning track uses short pieces of fiction to explore issues of ethical character, leadership, and organizational responsibility. Each student keeps an ethics journal over the course of the semester to reflect on ethical issues, both inside and outside the classroom. In addition, small student groups are formed to write case studies focusing on a business ethics problem.

MGMT 465. Perspectives in European Management. 3 Units.
The European Institute provides an introduction to international business through a unique combination of class meetings and an excursion to Europe. While in Europe, students meet with local business people, consulate officials, and university professors to learn the prerequisites for doing business in the region. The trip features site visits to local companies.

MGMT 467. Commercialization and Intellectual Property Management. 3 Units.
This interdisciplinary course covers a variety of topics, including principles of intellectual property and intellectual property management, business strategies and modeling relevant to the creation of start-up companies and exploitation of IP rights as they relate to biomedical-related inventions. The goal of this course is to address issues relating to the commercialization of biomedical-related inventions by exposing law students, MBA students, and Ph.D. candidates (in genetics and proteomics) to the challenges and opportunities encountered when attempting to develop biomedical intellectual property from the point of early discovery to the clinic and market. Specifically, this course seeks to provide students with the ability to value a given technological advance or invention holistically, focusing on issues that extend beyond scientific efficacy and include patient and practitioner value propositions, legal and intellectual property protection, business modeling, potential market impacts, market competition, and ethical, social, and healthcare practitioner acceptance. During this course, law students, MBA students, and Ph.D. candidates in genomics and proteomics will work in teams of five (two laws students, two MBA students and one Ph.D. candidate), focusing on issues of commercialization and IP management of biomedical-related inventions. The instructors will be drawn from the law school, business school, and technology-transfer office. Please visit the following website for more information: fusioninnovate.com. Offered as LAWS 5341, MGMT 467, GENE 367, GENE 467, EBME 467 and EECS 467.

MGMT 470. Corporate Governance. 3 Units.
This course is geared to enabling students to accelerate their careers and to rise to the very top echelons of management. Top CEOs from prominent regional businesses will share what they look for when they hire MBAs and they will suggest strategies for advancing through entry level and middle management to senior management. Improving your interviewing technique will be featured. The course will give students a top down look at career success. The role of the board of directors will also be explored. The best practices learned will be applicable to for-profit businesses and non-profit organizations, including health care.
MGMT 495A. AMES Business Model. 3 Units.
AMES BUSINESS MODELS is an experiential 2nd year MBA course built around the challenge of developing a business model for a company or organization. Students will have the opportunity to work on teams on three distinct projects across two semesters. The first project will involve helping develop the core business model for a start-up company or a newly commercialized technology coming out of CWRU. The second project will focus on business models for existing product lines within mature companies (small, medium or large enterprises). The third project will involve the business model of a company located outside of the United States. The first semester will enable “enterprise wide” learning from various local, startup organizations is broken into two segments with the first semester of in class research and analysis of organizations and will teach students to capture the gestalt of a company and its issues relating to its business with case studies. This semester will also involve sharing practitioner and academic approaches to developing strategic business models such as Alexander Osterwalder’s business model canvas as well as design approaches. Student teams will engage in three business model projects across the two semesters. They will come up with a set of hypotheses with the teaching staff and sponsors and then test their assumptions through a customer discovery and user research process. Students will work in teams to analyze the current situation and identify related problems/opportunities, conduct research, creatively envision alternatives, and recommend an appropriate course of action and next steps around the specified business model. Student projects will take place with companies or organizations in Cleveland or outside of the region (including international projects). Prereq: Full-time MBA program only.

MGMT 495B. AMES Business Models II. 3 Units.
AMES BUSINESS MODELS is an experiential 2nd year MBA course built around the challenge of developing a business model for a company or organization. Students will have the opportunity to work on teams on three distinct projects across two semesters. The first project will involve helping develop the core business model for a start-up company or a newly commercialized technology coming out of CWRU. The second project will focus on business models for existing product lines within mature companies (small, medium or large enterprises). The third project will involve the business model of a company located outside of the United States. The first semester will enable “enterprise wide” learning from various local, startup organizations is broken into two segments with the first semester of in class research and analysis of organizations and will teach students to capture the gestalt of a company and its issues relating to its business with case studies. This semester will also involve sharing practitioner and academic approaches to developing strategic business models such as Alexander Osterwalder’s business model canvas as well as design approaches. Student teams will engage in three business model projects across the two semesters. They will come up with a set of hypotheses with the teaching staff and sponsors and then test their assumptions through a customer discovery and user research process. Students will work in teams to analyze the current situation and identify related problems/opportunities, conduct research, creatively envision alternatives, and recommend an appropriate course of action and next steps around the specified business model. Student projects will take place with companies or organizations in Cleveland or outside of the region (including international projects). Prereq: Full-time MBA program only.

MGMT 497. Action Learning Project. 3 Units.
This course allows teams of students to integrate functional, core knowledge and apply analysis and strategic management skills in a real-world setting. Students will be evaluated by the instructor and the project managers at the client organizations. Prereq: MSM Healthcare or Part-Time Cohort MBA students only.

MGMT 499. Strategic Issues and Applications. 3 Units.
This course wraps up the M.B.A. core by providing an integrative experience of applying the full range of managerial skills addressed throughout the core in a comprehensive case exercise. Students develop, document, and present comprehensive, implementable strategic and tactical actions programs in groups. Prereq: ACCT 401 and BAFI 402.

MGMT 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

MGMT 560. Theoretical Perspectives in Management. 3 Units.
This seminar exposes students to management theories from a variety of disciplines. The goal of the course is to help students learn to synthesize and contrast theories to develop hypotheses of their own. Prereq: Ph.D. standing or consent of instructor.

MGMT 571. Measurement Theory and Method. 3 Units.
This doctoral seminar focuses on the theoretical and methodological issues involved in social science measurement. Specifically, the course will cover topics in basic principles of measurement including Classical Test Theory, Reliability, Validity, and Item Response Theory, as well as related tools for measurement analysis including Exploratory and Confirmatory Factor analysis. In addition, the course will expose students to analytical methods that model measurement error in simultaneous equations including models with mediation and moderation effects. This course involves extensive use of statistical packages including SPSS, LISREL, and EQS. Prereq: Ph.D. standing.

MGMT 573. Applied Multivariate Data Analysis. 3 Units.
The objectives of the seminar are to provide students with an understanding of the substantive and methodological issues involved in applied multivariate data analysis. The seminar aims to expose students to the assumptions, principles and applications of a selected set of multivariate techniques including Logistic Regression, MANOVA/ Discriminant, Profile, Multilevel and Latent Growth Model analysis. This course involves extensive use of statistical packages including SPSS, LISREL, and EQS. Prereq: Ph.D. standing.

MGMT 602. Advanced Topics. 1 - 18 Units.
This is a course of flexible design to meet advanced theoretical and/or methodological needs of doctoral students. Approval is needed from the instructor, and it requires a letter grade.

MGMT 610. Culture and World Politics. 3 Units.
Religion, ethnicity, and nationalism have assumed major political significance in the post Cold-War and post-9/11 eras. The course examines ideas of political democracy and economic liberalism in relation to different cultural and religious ideas and explores relationships among social values, political structures, and economics. Prereq: Only for students in PhD in Management: Designing Sustainable Systems, or by permission of the Program Director.
MGMT 611. Theory and Practice of Collective Action. 3 Units.
The ability of autonomous and interdependent parties to coordinate actions, or to act cooperatively, affects a wide range of organizational and social problems. This course addresses the theory and practice of collective action in local, national and global contexts. Case studies of collective action problems, such as environmental protection, community revitalization, and the mobilization of interest groups will be discussed. Prereq: Must be enrolled in Ph.D in Management: Designing Systems track.

MGMT 614. Business as an Evolving Complex System. 3 Units.
The goal of this course is to provide a foundation for understanding how business systems evolve, why the business systems in the major advanced countries have evolved differently over the last 100 years or so, and what the underlying driving forces are. The focus is on transformation rather than economic growth. The course examines the evolution of business systems as a result of technological and organizational change. It deals with the role of history, culture and finance in generating business organizations in various countries. The course also studies the emergence of regional innovation systems and industry clusters, as well as how digitization and globalization are changing the industrial logic. Prereq: Must be enrolled in PhD in Mgt: Designing Sustainable Systems.

MGMT 616. Global Economic Systems and Issues. 3 Units.
This course provides a framework and analytical tools for understanding globalization and international economic relations in the context of the global political system. It analyzes the economic and political forces that are shaping global cooperation on economic matters, the role and impact of international economic institutions such as the World Bank, the International Monetary Fund, and the World Trade Organization, and evolving forms of regional governance, such as the European Union. It covers national and international policies and development and the causes and cures of international financial crises. The course revolves around concepts of efficiency, equality, power and institutions in the making of public policy towards globalization of communications and transportation. Prereq: Must be enrolled in Ph.D in Management: Designing Systems track.

MGMT 617. Technology and Social System Design. 3 Units.
This course explores the process of design to become a better designer and interventionist who anticipates and evaluates the social, economic, and political consequences of existing and emerging products, processes, and organizational forms. Prereq: Must be enrolled in PhD in Management: Designing System Systems track.

MGMT 640. Social Ethics: Contemporary Issues. 3 Units.
The course draws upon intellectual ancestors and current thinkers in moral philosophy and ethics to assist each student in identifying, analyzing, and discussing social and ethical questions pertaining to the definition and purpose of contemporary life, the need for moral coherence, and the meaning of life in a global society. The unifying theme of the course is Tolstoy's question, "How then shall we live?" The course does not seek to provide answers to the great questions of life. Rather, it tries to expand each student's capacity to grapple with such questions. Prereq: Students in PhD Management program or requisites not met permission.

MGMT 641. Qualitative Res Methods II. 3 Units.
This course guides the student in conducting the qualitative research project that was proposed in EDMP 638. Fieldwork and initial analysis is conducted during the summer when data based on semi-structure interviews is collected and analysis begins using inductive coding techniques. A summer residency is held in mid-June to assess progress as final data collection and analysis continues. The aim of the fall semester is to prepare a formal research report on that project, which will be submitted to an academic research conference. The final report includes a revision of one's conceptual model, integrating new understandings and literature arising from the data collection and analysis. Prereq: Only for students in PhD in Management: Designing Sustainable Systems, or by permission of the Program Director.

MGMT 643. Measuring Bus Behav & Struc. 3 Units.
This course aims to develop the basic foundations and skills for designing and executing generalizable studies that measure business behaviors and structures. It focuses on building competence in building measurement systems, construct measurement, research design, data collection methodologies, and application of analytical software commonly involved in quantitative inquiry. Covered topics include framing research questions, reliability and validity of measurement, quasi-experimental research design, and fieldwork for data collection. Classes are designed to balance theory and practice through quantitative research design and will be linked to the participant’s own research project. Prereq: Only for students in PhD in Management: Designing Sustainable Systems, or by permission of the Program Director.

MGMT 645. Integration of Qualitative and Quantitative Inquiry. 3 Units.
Using the mixed method research toolkit developed in previous courses, this course focuses on critically analyzing selected pieces of published applied and policy research to develop a critical appreciation of issues and debates that have wide applicability and relevance. In particular, it offers students ways to integrate and triangulate using a mixed method approach, different forms of evidence, and related evidence. In addition, this course addresses common method choice and justification issues and related challenges of validity and theory formulation that typically arise during the students' execution of a series of individual research projects. Application of critical analysis and appreciative approach in justifying mixed methods designs to the student’s own research work is encouraged and supported by sharing and discussing common research and methodology themes and problems. Prereq: Students in PhD Management program or requisites not met permission.

MGMT 646. Advanced Analytical Methods for Generalizing Research. 3 Units.
This course addresses advanced topics in regression and structural equation modeling such as latent growth curve models, partial least squares, logit models, tests for various types of invariance, multiple-group analysis, multilevel analysis, and analyzing qualitative/categorical data. These analytical methods are intended to enhance the student’s toolkit as to facilitate a strong bridge to the academic literature and the application to specific data based problems that arise in applied managerial research. Prereq: Students in PhD Management program or requisites not met permission.
MGMT 648. Causal Analy of Bus Prob I. 3 Units.
Causal Analysis of Business Problems I introduces fundamental concepts in theory-based model building and validation. In this course students will develop, explore, refine a range of models appropriate for addressing their problem of practice including classification models, process models, variance models, and articulating nomological networks. In particular, the course will focus on effective conceptualizations of causation, control, mediation, and moderation. Further, foundational statistical techniques such as tests of assumptions of the data, exploratory factor analysis, and regression and path analysis will be introduced to analyze concepts of causation, control, mediation and moderation. Prereq: Only for students in PhD in Management: Designing Sustainable Systems, or by permission of the Program Director.

MGMT 649. Causal Analy of Bus Prob II. 3 Units.
Building upon the first course in Causal Analysis of Business Problems, this course will guide students through the theoretically-grounded variance models that are required for testing through structural equation modeling (SEM) in the quantitative portion of their research. Fundamental concepts in model testing will be reinforced using path analysis, and will include a deeper exploration of moderation by addressing topics such as moderated mediation and interaction effects. Beyond the analysis the course will emphasize precise and accurate formulation of theoretical models and associated reasoning, as well as careful interpretation of findings. The class will also delve into testing of data assumptions and prepare students for the model testing portion of their capstone assignments. Prereq: Only for students in PhD in Management: Designing Sustainable Systems, or by permission of the Program Director.

MGMT 664. Knowledge Dissemination to Influence Managerial Practice. 3 Units.
The aim of this course is twofold. First, it supports students organizing and writing their DM thesis overview or their PhD thesis proposal. Also discussed are ways to organize and communicate in scientific genres, their aims and their generic properties. Secondly, students become acquainted with scientific communication and publishing. Effective reviewing, criteria for judging articles and theses, management of review processes, and how to communicate and respond to reviews are topics discussed. The course also addresses publication strategies and ways of managing and communicating scientific and managerial knowledge to different stakeholders. Prereq: Students in PhD Management program or requisites not met permission.

MGMT 667. Designing Sustainable Systems. 3 Units.
Students in teams will recognize and work in practice on a managerial problem that involves dimensions of sustainability and design. They will develop a set of solutions to the problem by generating alternative models and intervention strategies to address the problem. The project results in a short presentation and written communication of the solution in a form of a poster or prototype. The course will also include presentations of intervention and action research approaches and issues of inquiry validation and theory development. Prereq: Only for students in PhD in Management: Designing Sustainable Systems.

MGMT 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Must be enrolled in Ph.D. in Management: Designing Sustainable Systems and have predoctoral research consent or advanced to Ph.D. candidacy milestone.

MIDS Courses

MIDS 301. Introduction to Information: A Systems and Design Approach. 3 Units.
Managers must design business systems and flows of information that enable an organization to operate successfully in changing environments. This course will explore what "design," "systems," "information" and "environment" really mean in this context. You will develop a systems and design perspective on information and organizations that will inform your future work as a manager and leader. You will learn how to model organizations and their environments to reveal how they reflect foundational concepts of information theory, cybernetic control and complexity. You will also learn to evaluate multiple levels of information design, including communication design, product design, experience design and organization design, as an integral part of your management skills. In addition, you will study the strategic use of contemporary information technologies (e.g., enterprise systems, cloud computing, crowd sourcing, viral marketing, distributed innovation, and social media) to understand how they have changed the competitive landscape of business. Throughout the course, you will be challenged to develop new skills for analyzing organizations, environments and systems, and for using design concepts and methods to create information environments that will enable successful organizations.
MIDS 360. Independent Study. 1 - 18 Units.

MIDS 420A. Design in Management: Concept and Practices. 3 Units.
Designing is giving form to an idea to conceive of a more desirable product, service, process or organization and refining the idea into something that can be delivered reliably and efficiently. Good design integrates these evolving ideas with the day-to-day realities of a firm's operations, systems, marketing, economics, finance and human resources. Designing is thus a unique managerial activity that brings together changing technologies, capabilities, relationships, activities and materials to shape an organization's plans and strategies. It combines analysis and synthesis in ways that are integrative and inventive, and through it managers create opportunities and means of attaining them. Viewed this way, designing is a core competence of a successful entrepreneur or innovative leader. This course is the first in a two-semester sequence. Design analysis is the systematic review of the four orders of design found in every firm—namely, the firm's communications, products, interactions and environments—and the creation of opportunities to increase firm value by improving each. Students will identify ill-defined, ill-structured problems within organizations. Such problems are ones for which there are no definitive formulations and for which the formulation chosen affects the solutions available. For such problems, there is no explicit way of knowing when you have reached a solution, and solutions cannot necessarily be considered correct or incorrect. But finding innovative solutions to such problems can provide unique opportunities to distinguish organizations and to create exceptional value. A major outcome of the semester's inquiry is a presentation of the challenges and opportunities discovered during the design analysis of the client organization. The presentation will include a conceptualization of the client's current situation and opportunities, along with a statement of their design requirements. It is successful to the extent that it demonstrates learning by creating unexpected value to the client.

MIDS 420B. Design in Management: Concept and Practices. 3 Units.
Designing is giving form to an idea to conceive of a more desirable product, service, process or organization and refining the idea into something that can be delivered reliably and efficiently. Good design integrates these evolving ideas with the day-to-day realities of a firm's operations, systems, marketing, economics, finance and human resources. Designing is thus a unique managerial activity that brings together changing technologies, capabilities, relationships, activities and materials to shape an organization's plans and strategies. It combines analysis and synthesis in ways that are integrative and inventive, and through it manages to create opportunities and means of attaining them. Viewed this way, designing is a core competence of a successful entrepreneur or innovative leader. This course is the first in a two-semester sequence. Design analysis is the systematic review of the four orders of design found in every firm—namely, the firm's communications, products, interactions and environments—and the creation of opportunities to increase firm value by improving each. Students will identify ill-defined, ill-structured problems within organizations. Such problems are ones for which there are no definitive formulations and for which the formulation chosen affects the solutions available. For such problems, there is no explicit way of knowing when you have reached a solution, and solutions cannot necessarily be considered correct or incorrect. But finding innovative solutions to such problems can provide unique opportunities to distinguish organizations and to create exceptional value. A major outcome of the semester's inquiry is a presentation of the challenges and opportunities discovered during the design analysis of the client organization. The presentation will include a conceptualization of the client's current situation and opportunities, along with a statement of their design requirements. It is successful to the extent that it demonstrates learning by creating unexpected value to the client. Prereq: MIDS 420A.

MKMR Courses

MKMR 201. Marketing Management. 3 Units.
This is an introductory marketing course designed to provide students with the concepts and theories necessary for understanding the fundamental principles of marketing and its role in any organization. Students will learn concepts such as marketing orientation, marketing-mix, relationship marketing and service logic, as well as behavioral theories of customer response and strategic frameworks of customer brand management. Students develop capabilities for understanding marketing issues in real world situations and to create and implement basic marketing plans. Prereq: At least Sophomore standing.

MKMR 304. Brand Management. 3 Units.
Successful innovation and management of brands and products creates customer, firm, and societal value. This course is designed to help students understand the principles of product and brand development and management such as understanding evolving customer needs; creating and delivering the right products, services, and experiences; and managing the process to enhance brand equity and customer satisfaction. Through text, cases, and simulation this engaging class will cover the branding process from new brand and product development; brand communication and promotion, and brand equity measurement. The course will also discuss specific topics such as global brands, brand extensions, brand revitalization, and social responsibility. Prereq: ACCT 102, ECON 102 and MKMR 201.
MKMR 308. Measuring Marketing Performance. 3 Units.
Evaluation and control are important strategic marketing processes and without effective and consistent measurement, these processes cannot be performed adequately. In recent years, marketing budgets have been challenged by top managers as the value of these expenditures to an organization's financial well being is not often clear. Marketing activities such as advertising, sales promotions, sales force allocation, new product development, and pricing all involve upfront investments and making these investments now require increasing scrutiny. This course will be about knowing and understanding what to measure, how to measure, and how to report it so the link between marketing tactics and financial outcomes is clearer. The course will include lecture by the instructor, readings, cases, computer based data exercises, and guest lectures. There will also be a team project requirement. Prereq: ACCT 101 or 203, ECON 102 and MKMR 201

MKMR 310. Marketing Analytics. 3 Units.
To appreciate, design, and implement data-based marketing studies for extracting valid and useful insights for managerial action that yield attractive ROI, five essential processes are emphasized: (a) making observations about customers, competitors, and markets, (b) recognizing, formulating, and refining meaningful problems as opportunities for managerial action, (c) developing and specifying testable models of marketing phenomenon, (d) designing and implementing research designs for valid data, and (e) rigorous analysis for uncovering and testing patterns and mechanisms from marketing data. Offered as MKMR 310 and ECON 310. Prereq: MKMR 201 and OPRE 207.

MKMR 311. Customer Relationship Management. 3 Units.
Customer Relationship Management (CRM) is the strategic process of building and maintaining profitable, sustainable customer relationships through co-creation of value with customers in both business-to-business (B2B) and business-to-consumer (B2C) markets. This course starts with understanding the relationship between an organization's strategic goals and the structure and dynamics of organization-customer relationships. Topics include assessing CRM system design, implementation and management; the fundamentals of customer profitability analysis; customer portfolio management; B2B relationship management; sales force management and automation; and designing services programs to optimize customer experiences; and expanding customer relationships through services. Additionally, students will explore how one-to-one marketing and social networks enhance customer relationships. Learning will be accomplished through lecture and discussion, critical discussion of case studies and contemporary marketing issues, and interaction with experienced CRM marketing professionals. Prereq: MKMR 201.

MKMR 312. Selling and Sales Management. 3 Units.
Selling and sales management are keys to implementing an organization’s marketing program and customer relationships. This course emphasizes developing an understanding of basic marketing concepts, selling principles, interrelationships among sales force management and other business functions, appropriate strategy for managing a sales force and measurement of sales force productivity. We will use theories of work motivation and explore how individual difference variables influence the choices of sales managers. This course uses a synthesis of sales research and leading practices to focuses on both a strategic and a tactical perspective. Strategic issues include: entrepreneurial strategy, the sales force’s role in company strategy, customer relationship and strategic account management, sales force size and organization and career paths to sales management. Tactical issues include: effective approaches to selling, finding and retaining top sales talent, motivating and compensating the field force, evaluating performance, and aligning sales territories. Prereq: MKMR 201 or MKMR 301.

MKMR 348. Strategic Internet Marketing. 3 Units.
This course aims to prepare business students to think strategically and make effective marketing decisions in networked business environments. Given the increasing strategic significance of the internet across a broad spectrum of industries, it is imperative that business students develop a deep understanding of the emerging digital marketplace. The course will focus on the following topics: The emerging digital world; individuals and firms online; network technologies; business models on the internet; online branding; customer relationship management and loyalty in electronic markets; internet’s impact on innovation and product management; online retailing; business-to-business e-commerce; multi-channel management; sustainable competitive advantage in the digital marketplace; legal, ethical, and public policy issues related to digital technologies; organizing for online marketing. Prereq: MKMR 201.

MKMR 355. Communications Management in a Digital Marketplace. 3 Units.
In a marketplace where consumer touchpoints have gone digital and new digital methods of connecting with the consumers are emerging, this course provides a sound understanding of management of an organization's total marketing communications. The focus is on identifying appropriate strategy and tactics for effectively communicating with end consumers and other stakeholders/public in both conventional ways and also in new and emerging ways. Students examine the roles of advertising, sales promotion and public relations, along with below the line methods like direct response advertising, and Internet based methods including display and search advertising, affiliate marketing and viral campaigns. They work with developing and managing these elements as part of an overall, synergistic communications strategy. Perspectives and metrics for evaluation of the effectiveness of marketing communications are also introduced and discussed. Prereq: MKMR 301.

MKMR 360. Independent Study. 1 - 3 Units.
This course is offered, with permission, to students undertaking reading and research in an area of their special interest.

MKMR 403. Managerial Marketing. 3 Units.
This course focuses on managing marketing as a process of creating value and mutually desirable exchanges of values. That is the foundation of a customer orientation and a central theme of market-driven management. Methods for strategic marketing planning, understanding buyer behavior, market analysis, segmentation and devising integrated marketing programs are introduced. Creating customer value and competitive advantage in worldwide markets is the central theme. Prereq: ACCT 401.
MKMR 405. Business Marketing. 3 Units.
This course focuses on concepts and practices of business-to-business marketing of products and services. It also examines how rapid technological change impacts industrial markets. Topics covered include: buyer-seller relationship building, competitive bidding, developing markets for new materials and value-based pricing strategies. Marketing to the government, marketing of intellectual property and marketing-R&D-manufacturing interface issues will also be explored. Prereq: MKMR 403 or MBAP 407 or MBAC 506 or (GMBA 401A and GMBA 402A and GMBA 403A and GMBA 401B and GMBA 402B and GMBA 403B).

MKMR 408. Marketing Metrics. 3 Units.
Evaluation and control are important strategic marketing processes and without effective and consistent measurement, these processes cannot be performed adequately. In recent years, marketing budgets have been challenged by top managers as the value of these expenditures to an organization's financial well being is not often clear. Marketing activities such as advertising, sales promotions, sales force allocation, new product development and pricing all involve up-front investments and making these investments now require increasing scrutiny. This course will be about knowing and understanding what to measure, how to measure and how to report it so the link between marketing tactics and financial outcomes is clearer. The course will include lecture by the instructor, readings (no textbook), cases, computer based data exercises and guest lectures. There will also be a team project requirement. Prereq: MBAC 506 or MKMR 403 or MBAP 407 or GMBA 401A.

MKMR 410. Marketing Insight Management. 3 Units.
To appreciate, design, and implement data-based marketing studies for extracting valid and useful insights for managerial action that yield attractive ROI. Five essential processes are emphasized: (a) making observations about customers, competitors, and markets, (b) recognizing, formulating, and refining meaningful problems as opportunities for managerial action, (c) developing and specifying testable models of marketing phenomenon, (d) designing and implementing research designs for valid data, and (e) rigorous analysis for uncovering and testing patterns and mechanisms from marketing data. Prereq: MKMR 403 or MBAC 506 or MBAP 407.

MKMR 411. Customer Relationship Management. 3 Units.
Customer Relationship Management (CRM) is the strategic process of building and maintaining profitable customer relationships through co-creation of value with customers. This course starts with understanding the relationship between an organization's strategic goals and customer relationships, including assessing CRM systems, management and implementation, in both B2B and B2C markets. Students will learn the fundamentals of customer profitability analysis, customer portfolio management, B2B relationship/sales force management and automation, designing services to optimize customer experiences, as well as expanding customer relationships through services. Additionally, students will explore how one-to-one marketing and social networks enhance customer relationships. Learning will be accomplished through critical discussion of case studies and contemporary marketing issues, and hands-on group project and presentation, and interaction with experienced CRM marketing professionals. Prereq: MKMR 403 or MBAP 407 or MBAC 506 or (GMBA 401A and GMBA 402A and GMBA 403A and GMBA 401B and GMBA 402B and GMBA 403B).

MKMR 412. E-Marketing. 3 Units.
Using a combination of lectures, cases, and hands-on projects, the course examines how the Internet influences all the key aspects of marketing, including marketing strategy, pricing, advertising, segmentation, marketing research, retailing, distribution channels, and international marketing. Additionally, the course will cover more Internet specific topics such as privacy, wireless web, sales force automation, and emarketplace models. The course incorporates both business-to-business and business-to-consumer Outlooks.

MKMR 421. Marketing Value Creation. 3 Units.
Marketing value creation is the process of creating and managing successful brands through continuous innovation. Successful brand innovation and management requires understanding evolving customer needs; creating and delivering the right products, services, and experiences; and managing the process to enhance brand equity and customer satisfaction. Through text, readings, cases, high-profile guest lectures and team projects, this engaging class will cover the innovation and branding process from discovery of unmet needs, brand and product development, to brand promotion and advertising and brand equity measurement. A sustainability thread will weave throughout the course, covering topics such as brand's ecological footprint, product safety, eco-friendly branding, the ethics of advertising, the impact of pricing on consumers and corporate social responsibility. The result of proper sensitivity to customer needs, social concerns and the environment is integral to the process of value creation for customers, companies and society. Prereq: MKMR 403 or MBAC 506 or MBAP 407 or GMBA 403A.

MKMR 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading or a project in a field of special interest.

MKMR 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

MPOD Courses

MPOD 413A. Foundations of Positive Organization Development and Change. 3 Units.
This course explores and develops the art of reading and understanding social systems in ways that help us imagine, design and develop organization excellence. First it seeks to show how many of our conventional ideas about organizations are based on discourse and metaphors that lead us to see and understand organizations in partial and often limiting ways. Growing research from the domains of Positive Psychology and Positive Organization Scholarship and the theory and practice of Appreciative Inquiry will be explored to show how we can create new and more positive, strength-based ways of designing and developing social systems. Includes presentations, guest lectures and panel discussions on current topics of interest for the Masters in Positive Organization Development and Change (MPOD) candidates. Led by a faculty member of the Department of Organization Behavior, these dialogues and seminars will be presented in several of the six main residencies of the MPOD program. Reflective essays and integrative papers will enable participants to explore their practice of OD, leadership capacity, application of learnings from the program and deeply held values related to current issues and opportunities in the domain of human systems change and development. Part One of Two. Prereq: Open to MPOD candidates only.
MPOD 413B. Foundations of Positive Organization Development and Change. 1 Unit.
This course explores and develops the art of reading and understanding social systems in ways that help us imagine, design and develop organization excellence. First it seeks to show how many of our conventional ideas about organizations are based on discourse and metaphors that lead us to see and understand organizations in partial and often limiting ways. Growing research from the domains of Positive Psychology and Positive Organization Scholarship and the theory and practice of Appreciative Inquiry will be explored to show how we can create new and more positive, strength-based ways of designing and developing social systems. Includes presentations, guest lectures and panel discussions on current topics of interest for the Masters in Positive Organization Development and Change (MPOD) candidates. Led by a faculty member of the Department of Organization Behavior, these dialogues and seminars will be presented in several of the six main residencies of the MPOD program. Reflective essays and integrative papers will enable participants to explore their practice of OD, leadership capacity, application of learnings from the program and deeply held values related to current issues and opportunities in the domain of human systems change and development. Part Two of Two. Prereq: MPOD 413A.

MPOD 414. Organization Design for a Knowledge World. 3 Units.
The objective of this course is to familiarize participants with the theory and technique of organization design and corporate change with particular emphasis on helping leaders understand and implement the latest forms of organizing in a customer-focused, electronically mediated and knowledge-driven world. Frameworks presented will be used to explore the impact of the information revolution on organization design and change, and the evolution of traditional vertically integrated and multi-divisional enterprises toward spider web structures, trans-organizational networks and communities of practice. Prereq: Open to MPOD candidates only.

MPOD 416A. Leadership, Executive Assessment and Development. 1 Unit.
Leadership with emotional intelligence will be examined by studying a number of topics and applying them to two major case studies: 1) a CEO; and 2) yourself. In this context, coaching the development of leadership will be a major topic throughout the course. This course will explore questions such as: Who are effective leaders? Are they different from effective managers? How do they think and act? What makes us want to follow them? How are leaders developed? What and how can people (you) help/coach others develop their competencies to become more effective leaders? (Part one of a three-section course.) Prereq: MPOD 416B.

MPOD 416B. Leadership and Executive Assessment and Development. 1 Unit.
Leadership with emotional intelligence will be examined by studying a number of topics and applying them to two major case studies: 1) a CEO; and 2) yourself. In this context, coaching the development of leadership will be a major topic throughout the course. This course will explore questions such as: Who are effective leaders? Are they different from effective managers? How do they think and act? What makes us want to follow them? How are leaders developed? What and how can people (you) help/coach others develop their competencies to become more effective leaders? (Part three of a three-section course.) Prereq: MPOD 416B.

MPOD 418. Flourishing Enterprise. 2 Units.
Global issues such as climate change and food security, as well as heightened expectations for personal health and well-being in the workplace, are introducing greater levels of complexity into business strategy and operations, with far-reaching implications for customer satisfaction and employee engagement. Effective handling of these issues can lead to new sources of revenue generation and cost efficiency, as well as reputational value, while failure to do so can lead to financial and competitive risk. Prereq: Open to MPOD candidates only.

MPOD 431. Experiential Learning for Individuals, Teams, and Organizations. 3 Units.
This course focuses on the theory of experiential learning and its application at the individual, team, and organizational levels of analyses. This course offers the chance for students to gain insight into their individual learning and adaptive styles, and how such styles impact the way they interact and have consequence for team. The course also explores how teams and organizations learn, and the effect that cultural determinants have on learning and adaptability. In addition, the course examines how learning theory can be applied to focused institutional development projects and educational processes. The course uses presentations, lectures, research findings, interactive activities, and class discussion. The current topics of interest are for the Masters in Positive Organization and Change (MPOD) candidates. It is led by a faculty member of the Department of Organization Behavior. Reflective essays and integrative papers will enable participants to explore their learning styles and that of their organizations and teams to strengthen the practice of OD and human systems change and development. Prereq: MPOD students only.

MPOD 431B. Experiential Learning for Individuals, Teams, and Organizations. 1 Unit.
This course focuses on the theory of experiential learning and its application at the individual, team, and organizational levels of analyses. This course offers the chance for students to gain insight into their individual learning and adaptive styles, and how such styles impact the way they interact and have consequence for team. The course also explores how teams and organizations learn, and the effect that cultural determinants have on learning and adaptability. In addition, the course examines how learning theory can be applied to focused institutional development projects and educational processes. The course uses presentations, lectures, research findings, interactive activities, and class discussion. The current topics of interest are for the Masters in Positive Organization and Change (MPOD) candidates. It is led by a faculty member of the Department of Organization Behavior. Reflective essays and integrative papers will enable participants to explore their learning styles and that of their organizations and teams to strengthen the practice of OD and human systems change and development. Part two of two. Prereq: MPOD 431A.
MPOD 432. Interpersonal Skills Building. 2 Units.
The objective of this course is to hone the participant's abilities to use themselves as instruments of change and development in relationships with colleagues and clients. This requires comfort with and practice in intervening in a broad range of interpersonal and group dynamics, and knowledge of how one's unique personal style and character serve as both strengths and weaknesses in dealing with others in a helping relationship. Participants will explore theories of adult development, interpersonal and group dynamics, diagnose their interpersonal needs and styles, and practice techniques for developing generative relationships with clients across the OD (organization development) cycle and as process consultants in group settings. Prereq: Open to MPOD candidates only.

MPOD 435. Practicum in Appreciative Inquiry and Positive OD. 3 Units.
This course develops participants' consultative skills. Competence in role entry and development, data collection, intervention and evaluation is gained through class exercises and field projects. The focus is on developing a problem-centered approach to intervening in organizations that minimizes reliance on programmed techniques and maximizes collaborative innovation and learning between client and consultant. Prereq: Open to MPOD candidates only.

MPOD 439A. Individual Field Project. 2 Units.
The objective of this course is to plan and execute a significant organization development, change and/or analysis project with an ongoing client or employer. Emphasis is placed on the craft of developing projects that are consistent with one's current skills, career plans and developmental needs, combined with the needs, opportunities, readiness, and resources of the client organization. This course is limited to candidates for the MPOD program. (Part one of a two section course.) Prereq: Open to MPOD candidates only.

MPOD 439B. Individual Field Project. 2 Units.
The objective of this course is to plan and execute a significant organization development, change and/or analysis project with an ongoing client or employer. Emphasis is placed on the craft of developing projects that are consistent with one's current skills, career plans and developmental needs, combined with the needs, opportunities, readiness, and resources of the client organization. This course is limited to candidates for the MPOD program. (Part two of a two-section course.) Prereq: MPOD 439A.

MPOD 470A. Leading Change from a Complexity Perspective. 1 Unit.
In this course, we will continuously attempt to answer two questions: (1) What is the process of sustained, desirable change? and (2) What is the role of a leader? Concepts from complexity theory will be used, including understanding the multilevel nature of SDC at the individual, dyad, team, organization, community, country, and global levels. Intentional Change Theory (ICT) will be used as the organizing concept for the changes studied. In this context, coaching the development of leadership will be a major topic throughout the course. Prereq: MPOD candidates only.

MPOD 470B. Leading Change from a Complexity Perspective. 2 Units.
In this course, we will continuously attempt to answer two questions: (1) What is the process of sustained, desirable change? and (2) What is the role of a leader? Concepts from complexity theory will be used, including understanding the multilevel nature of SDC at the individual, dyad, team, organization, community, country, and global levels. Intentional Change Theory (ICT) will be used as the organizing concept for the changes studied. In this context, coaching the development of leadership will be a major topic throughout the course. Prereq: MPOD candidates only.

MPOD 479. Foundations of Strategic Thinking. 3 Units.
This course will define what constitutes strategic change and what does not. Students will be introduced to a variety of strategic interventions and models from which to interpret, understand and achieve positive organizational change. Opportunity will be provided to apply selected models to the student's organization and other cases in order to gain insight and appreciation for financial and non-financial factors that influence fundamental organizational growth and development. Prereq: Open to MPOD candidates only.

MPOD 480. Dynamics of Effective Consulting Strategies. 3 Units.
This course will: 1) highlight the major current trends and changes that affect the nature of managerial work; 2) describe how OD practitioners and consultants need to factor such trends into their consulting strategies; 3) differentiate between types of interventions, the circumstances in which they apply and their unique strengths; 4) provide background theories that explain the challenges inherent in mobilizing positive change; 5) describe ways to bridge the gap between knowing and doing in order to build organization resilience; and 6) introduce a variety of consulting techniques and skills that the students can add to their repertoire. Prereq: Open to MPOD candidates only.

MPOD 498. Global Citizenship and Multi-Cultural OD: International Study Tour. 3 Units.
This course will broaden perspectives and knowledge of how OD principles and technologies are generated and applied in contexts and cultures outside of North America. Selected literature representing global perspectives on the practice of OD and field experiences will provide support and background for personal experience and reflection on cross-cultural issues in organizing. The primary learning context will be an intense, 10-day study tour to some country outside of North America to provide the participants with opportunities for: 1) comparative studies of OD practices in different cultural settings; 2) in-depth experiences with OD practitioners and students in a different national, regional and cultural context; 3) co-inquiry with non-North American students also involved in developing OD knowledge and skills; and 4) on-site organization visits outside of North America to observe and learn about ongoing dynamic change efforts. Prereq: Open to MPOD candidates only.

MSBA Courses
MSBA 400. Linear Algebra. 1 Unit.
The objective of this one-credit hour course is to provide a basic working knowledge of material in linear algebra that is relevant to the MSM-OR/SC and MSM-BA programs. This background material includes geometric and algebraic properties of vectors and matrices together with operations that can be performed on them. The use of vectors and matrices in solving systems of linear equations is taught. Offered as MSOR 400 and MSBA 400. Prereq: For MSM in Business Analytics students only.
MSBA 406. Operations Management. 3 Units.
Operations managers, ranging from supervisors to vice presidents, are concerned with the production of goods and services. More specifically, they are responsible for designing, running, controlling and improving the systems that accomplish production. This course is a broad-spectrum course with emphasis on techniques helpful to the practice of management at the analyst level. Its goal is to introduce you to the environments, to help you appreciate the problems that operations managers are confronted with, and provide you with the tools to address these problems. Operations Management spans all value-adding activities of an organization including product and process design, production, service delivery, distribution network and customer order management. As global competition in both goods and services increases, a firm’s survival depends upon how well it structures its operations to respond quickly to changing consumer needs. Thus, it is essential for all business managers to acquire an understanding of operations management to maintain their competitive advantage. This course provides students with the basic tools needed to become an analyst in Supply Chain and Operations Management. This course provides an overview of Process analysis, Capacity management, Queuing system, analysis, Forecasting, Quality management, Material Requirements planning, Inventory management, and Supply Chain management. The emphasis of the course is on both real world applications and technical problem solving. Several manufacturing and non-manufacturing environments will be discussed explicitly, like health care, insurance, hotel-management, airlines and government related operations. Also we will explore the interface of operations management with other functional areas such as marketing, finance, accounting, etc. This coursework includes individual and group assignments, case analyses and experiential learning through simulations and educational games. Offered as: MSOR 406 and MSBA 406.

MSBA 407. Managerial Marketing. 3 Units.
This course focuses on managing marketing as a process of creating value and mutually desirable exchanges of values. That is the foundation of a customer orientation and a central theme of market-driven management. Methods for strategic marketing planning, understanding buyer behavior, market analysis, segmentation and devising integrated marketing programs are introduced. Creating customer value and competitive advantage in worldwide markets is the central theme. Prereq: For MSM in Business Analytics students only.

MSBA 410. Accounting and Financial Management. 3 Units.
This course focuses on learning the language of business, how basic accounting information is reported and analyzed, and how basic financial principles can be applied to understanding how value is created within an enterprise. This course is intended for individuals who have a limited background in accounting, finance and business. Most of the exercises will involve evaluating and building models in Excel. Teaching objectives are fairly straightforward: 1. Provide you with a basic understanding of the key principles of accounting and finance. We will quickly cover material that is typically covered in a three-course sequence (Introductory Accounting and Finance I and II). We will fly at a fairly high level, but we want to make sure you understand the basic concepts. 2. Apply these concepts to real (but straightforward) business situations, to gain a better understanding of how companies utilize accounting and financial information. 3. Time permitting, explore how these concepts can be applied to securities, mergers and acquisitions and leveraged buyout transactions, with a specific emphasis on how these concepts are likely to surface in your role in such transactions. Offered as MSBA 410 and MSOR 410.

MSBA 411. Operations Analytics: Deterministic. 3 Units.
The first half of the course provides a practical coverage of linear programming, a special type of mathematical model. The art of formulating linear programs is taught through the use of systematic model-building techniques. The simplex algorithm for solving these models is developed from several points of view: geometric, conceptual, algebraic, and economic. The role and uses of duality theory are also presented. Students learn to obtain and interpret a solution from a computer package and how to use the associated output to answer "What-happens-if..." questions that arise in post-optimality analysis. Specific topics include: problem formulation, geometric and conceptual solution procedures, the simplex algorithm (phase 1 and phase 2), obtaining and interpreting computer output, duality theory, and sensitivity analysis. The second half of this course provide a practical approach to formulating and solving combinatorial optimization problems in the areas of networks, dynamic programming, project management (CPM), integer programming, and nonlinear programming. The art of formulating problems, understanding what is involved in solving them, and obtained and interpreting the solution from a computer package are shown. A comparison with formulating and solving linear programming problems is provided as a way to understand the advantages and disadvantages of some of these problems and solutions procedures. Recommended preparation: Knowledge of Excel, one semester each of undergraduate linear algebra and undergraduate calculus (derivatives); or consent of instructor. Prereq: For MSM in Business Analytics students only.

MSBA 432. Operations Analytics: Stochastic. 3 Units.
This course covers modeling and analysis of discrete-event dynamical systems using computer simulations. Topics include an introduction to simulation as a modeling tool, with emphasis on understanding the structure of a simulation model and how to build such models, model validation, random number generation, simulation languages, statistical simulation output analysis, design of simulation experiments and selected current research topics. Prereq: For MSM in Business Analytics students only.

MSBA 433. Foundations of Probability and Statistics. 3 Units.
Data of many kinds are typically available in practice, but the challenge is to use those data to make effective professional decisions. This software-intensive course begins with useful descriptions of data and the probability theory foundation on which statistics rests. It continues to statistics, including the central limit theorem, which explains why data often appear to be normally distributed, and the Palm-Khintchine theorem which explains why data often appear to have a Poisson distribution. The remainder of the course focuses on regression and forecasting, including detecting and overcoming some of the deadly sins of regression, and the surprising flexibility of regression models. Recommended preparation: One semester of undergraduate calculus or consent of instructor. Offered as MSOR 433, OPRE 433 and MSBA 433. Prereq: For MSM in Business Analytics students only.

MSBA 434. Data Mining & Visualization. 3 Units.
Data Mining is the process of identifying new patterns and insights in data. As the volume of data collected and stored in databases grows, there is a growing need to provide data summarization (e.g., through visualization), identify important patterns and trends, and act upon the findings. Insight derived from data mining can provide tremendous economic value, often crucial to businesses looking for competitive advantages. This course is a survey of data visualization methods, supervised and unsupervised learning techniques, and modern tools for discovering knowledge for business decisions. Prereq: For MSM in Business Analytics students only.
MSBA 435. Marketing Models & Digital Analytics. 3 Units.
Models & analytics suitable for digital marketing data are the focus of this course. The objective to develop analytical skills for making intelligent decisions about marketing investments that create value and build competitive advantage. In short, to build capabilities for marketing analytics for insights. The course content and assignments are designed to (a) enable student learning by using real-world problems and data, (b) emphasize the Problem-Data Analytics interdependence for effective problem solving, and (c) engage with thoughtful practitioners of digital data analytics to inform current practices and opportunities. Prereq: For MSM in Business Analytics students only.

MSBA 444. Predictive Modeling. 3 Units.
Predictive modeling is a set of procedures and tools for hypothesizing, testing and validating a model to explain and predict the probability or likelihood of a future event, or outcome. A wide range of procedures and tools are available for predictable modeling, and this course will cover a select set of topics with wide applicability. Through applications and case studies involving real-life data, the course will emphasize managerial problem solving. To build models is to capture managerial problem formulation, and to test/validate them is to confront managerial hypotheses with empirical observations. Problem solving is a creative act rooted in validated evidence of managerial hypotheses testing.

MSBA 445. Advanced Marketing Analytics. 3 Units.
In order to improve decision making in various decision areas of marketing like segmentation, positioning, advertising, sales promotions, new product development and pricing, use of quantitative data and analysis has become very popular. Among the strategic roles for measurement are evaluation and control. At the same time, marketing managers have been challenged by top managers’ demand to show the value of marketing expenditures to an organization’s financial well-being. This course will introduce a variety of data based decision-aids in the marketing area. In addition, the course will also introduce SAS to you. SAS is a very popular tool that analysts in business and economics field have been using for decades now.

MSBA 485A. Individual Development. 1.5 Unit.
This course is unique in the sense that its primary focus is on the student as an individual. In this course the student will get to know themselves better by completing assessments and making sense of them, having group discussions, presenting to a group as individuals, engaging in various experiential activities, conducting career interviews, attending various individual development programs and participating in two individual coaching sessions. Offered as: MSOR 485A and MSBA 485A. Prereq: For MSM in Business Analytics students only.

MSBA 485B. Team Development. 1.5 Unit.
This course is unique in the sense that its primary focus is on the student working in teams. In this course the student will assess their team-interaction based on team assignments simulated and action learning type projects, presenting to the class as a team, engaging in various experiential activities, participating one team coaching session, working with a team, and expanding their knowledge of team leadership and membership skills and abilities. They are also expected to engage with projects external to the university (similar to an action learning project). Offered as: MSOR 485B and MSBA 485B.

MSFI Courses

MSFI 401. Financial Orientation. 1.5 Unit.
This is a mandatory preparatory/refresher course for all entering MSM-Finance students. It will cover several basic topics in statistics, financial accounting and in financial management, so that all students can hit the road running with the other MSM-Finance core courses in the first semester. Prereq: For MSM-Finance students only.

MSFI 403. Corporate Finance. 3 Units.
The purpose of this course is to familiarize the student with the theory and application of additional models used in financial decision-making by corporations. Issues relating to efficient markets, dividend policy, capital structure, financing decisions, option pricing, leasing, and risk management are among the topics considered. In addition, special topics may include mergers and acquisitions, pension funds, and international financial management. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 404. Financial Modeling. 3 Units.
This is a course about financial modeling. It covers a range of topics in the field of financial economics. Each topic is chosen because it lends itself to financial modeling. The primary focus of the course is to relate the theory of finance to practical and usable spreadsheet models that will assist a financial manager with a firm’s investment and financing decisions. Spreadsheet models have been the dominant vehicle for finance professionals to practice their trade. This course will utilize Excel and challenge the student to improve their finance and modeling skills. Students will improve their familiarity with financial data analysis through various exercises that incorporate completed models. In summary, the course is designed to increase your practical understanding of core concepts in finance, help you develop hands-on spreadsheet modeling skills, and strengthen your ability to perform financial data analysis within an Excel model. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 421. Corporate Financial Analysis. 3 Units.
This course is designed to lay the analytic foundation for careers in corporate finance, banking, consulting, and investment banking. The objective of the course is to strengthen students’ conceptual understanding and problem-solving skills, and teach them how to think on their feet. Topics covered include Economic cash flows and valuation, Valuation methods, Long term financial planning and ratios analysis, Growth and external financing, Managerial options and valuation, Capital structure, and Payout policy. Topics covered may change from semester to semester. The course envisages use of spreadsheets and case studies, and will emphasize on links to real-world events. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 428. Financial Strategy and Value Creation. 3 Units.
The intersection between the theory of perfect markets and the reality of market imperfections provides the basis for the exploration of value creation in this course. Opportunities in both product and financial markets are explored using case studies to develop a framework for strategic financial decisions. Prereq: For MSF-MSM and ACL-MSF students only.
MSFI 429. Investment Management. 3 Units.
This course explores the characteristics of financial investments and markets and develops modern techniques of investment analysis and management. The goal is to help students develop a level of analytical skill and institutional knowledge sufficient to make sensible investment decisions. Topics include: an overview of stock, debt and derivative asset markets, practical applications of modern portfolio theory, equilibrium and arbitrage-based approaches to capital market pricing, the debate over market efficiency, the term structure of interest rates, bond portfolio management, and uses of derivative assets in investment portfolios. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 430. Derivatives and Risk Management. 3 Units.
This course is intended to give students an understanding of options and futures markets both in theory and practice. The emphasis is on arbitrage and hedging. The course concentrates on listed common stock and index contracts as well as commodity markets. Various theories for trading strategies are studied. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 431. Fixed Income Markets and Their Derivatives. 3 Units.
This class is concerned with fixed income securities, interest rate risk management, and credit risk. Fixed income securities account for about two thirds of the market value of all outstanding securities, and hence this topic is important. The course covers the basic products of fixed income markets including treasury and LIBOR products, such as interest rate swaps. Risk management and hedging strategies are covered as well as selected topics in credit risk models and mortgage-backed securities. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 432. Corporate Risk Management. 3 Units.
This is a risk management course aimed at developing an understanding of the risks faced by financial and nonfinancial firms, learning techniques to identify and measure these risks, and understanding how financial engineering (especially derivatives) can be used to manage these risks and advance the strategic goals of the firm. Main topics include Value-at-Risk (VaR) techniques and implementation of VaR systems (RiskMetrics, Delta-normal, Historical Simulation, Structured Monte-Carlo); financial risk measurement and management using forwards, futures, options, swaps, and exotics; and credit risk management, including implementing various credit risk and credit VaR models, estimating capital at risk, and using credit derivatives for managing credit risk. Several classes are devoted to discussing recent risk management debacles and relating them to theory. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 433. Quantitative Risk Modeling. 3 Units.
This course is designed to help students learn quantitative models for estimating risk in various financial settings for different types of financial institutions (banks, hedge funds, and others). It is a very hands-on course where students will become familiar with several state-of-the-art quantitative risk models as well as their detailed implementation procedure in the real world. The course uses several in-class Excel exercises to illustrate the models as well as their practical implementation using real financial data. Offered as BAFI 433 and MSFI 433. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 434. Financial Analytics and Banking. 3 Units.
This course will cover empirical and analytical aspects of banking, including loan origination, syndication, sales, stress-testing and securitization; capital adequacy, regulation and supervision; methods of measuring and managing value at risk, credit risk, interest rate risk, liquidity risk, and other risk; credit market information, feedback, and signaling. Offered as BAFI 434 and MSFI 434. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 435. Empirical Finance. 3 Units.
MSFI 435 provides an introduction to empirical analysis and research in finance. This involves the management of empirical datasets and the aspects of quantitative applications of finance theory. The goal is to enable the student to deal with the need to analyze complex and large financial and economic datasets that is present in many fields of the financial profession. The scope of the data as well as the quantitative methods used in such analysis often requires familiarity with robust computational environments and statistical packages. As such, another goal of the course is to familiarize the student with at least one such environment. Applications are conducted using real financial and economic data. The course draws on the theoretical aspects of the subjects covered, but mainly focuses on the practical matters required to undertake an empirical analysis of financial topics—e.g., the definition of the research question, the datasets required, the computational needs, and, then, the implementation. The course enables the student to evaluate outstanding financial research as well as to conduct his or her own research. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 436A. Individual, Team and Career Development. .75 Unit.
This course is designed to focus on three areas of development critical to students' personal and professional success: 1) Individual; 2) Team; and 3) Career. The individual and team aspects include developing self and other awareness through exploration of learning styles, process skills, and building communication and presentation competencies. Career development includes a focus on strategies for success such as networking, resume building, and learning from executives through intensive and interactive seminars. The course involves use of assessments, group discussions, presentations and experiential activities. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 436B. Individual, Team and Career Development. .75 Unit.
This course is designed to focus on three areas of development critical to students' personal and professional success: 1) Individual; 2) Team; and 3) Career. The individual and team aspects include developing self and other awareness through exploration of learning styles, process skills, and building communication and presentation competencies. Career development includes a focus on strategies for success such as networking, resume building, and learning from executives through intensive and interactive seminars. The course involves use of assessments, group discussions, presentations and experiential activities. Prereq: For MSF-MSM and ACL-MSF students only.
MSFI 440. Financial Decisions, Contracting & Value. 3 Units.
The firm is a nexus of contracts among its various stakeholders (managers, shareholders, debt holders etc.). In this course, we will examine how value is created, and how real world conflicts between the various stakeholders of a firm lead to deviations from “perfect world” solutions. For instance, you may have learned in basic corporate finance courses that it is optimal to invest in positive NPV projects. Real-world conflicts can make it sub-optimal for shareholders do so. We will examine such issues and ways to mitigate them. In particular, we will examine Valuation, Asymmetric Information, Agency Cost, Incentive Contracts and Performance Metrics, and, time permitting, also discuss Regulation, Reputation and the role of certifiers and the economic crises. The takeaway learnings from this course are: (a) Understanding how Value can be created or destroyed, (b) Measuring Value, (c) Understanding the links between capital structure and: asymmetric information, market reactions and signaling, agency and management incentives, taxes, shareholder-bondholder conflicts etc., (d) Understanding the links between payout policy and: informational content, market reaction, stock returns and signaling, clientele effects etc., and (e) Understanding the need for and the design of incentive mechanisms. Case studies will be used to reinforce learning. We will emphasize on links to real-world events. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 444. Entrepreneurial Finance. 3 Units.
The objective of this course is to introduce students to the issues of financial management and capital formation in new ventures. The course will address issues of estimation of cash requirements, development of pro forma financial plans, firm valuation and the process and tools used in raising debt and equity financing. Bootstrapping, angel investing, venture capital, strategic alliances and initial public offerings will be covered. The emphasis is on the entrepreneur and how he/she can assess financial needs and develop a sensible plan for acquiring financial resources in a manner that is consistent with their financial needs and other strategic goals. Offered as BAFI 444 and MSFI 444. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 450. Mergers and Acquisitions. 3 Units.
This course examines the economic rationale and motivation for the different merger and acquisition and recapitalization activity undertaken by firms and individuals in the U.S. market. Emphasis is on the different three (3) methods of valuing a firm, the various forms of debt and equity capital employed to fund mergers and acquisitions and recapitalizations, how lenders and investors structure their loans and/or investments, and how investors realize the gains through different exit strategies. The course gives the student an excellent understanding of the role that senior commercial banks, insurance companies, pensions funds, LBO funds, investment banking firms, and venture/growth capital investors play in mergers and acquisitions. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 460. Investment Strategies. 3 Units.
This course provides a broad survey of some of the main strategies used by hedge funds today. Through exercises and projects, the hedge fund strategies will be presented using real data. Students will learn to use a methodology referred to as “back testing” in order to evaluate hedge fund strategies. The course will also cover institutional details related to short selling, liquidity, margin requirements, risk management, and performance measurement. Since hedge funds today use advanced modeling techniques, the course will require students to analyze and manipulate real data using mathematical modeling. The objective of the course is for students to gain practical knowledge about creating, back-testing, and implementing hedge fund trading strategies. Offered as BAFI 460 and MSFI 460. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 470. Financial Models Using Big Data. 3 Units.
This course is focused on developing models in investments using financial big data. A strong theoretical base will be developed and then relevant empirical analyses using real data will be used for testing models, via individual assignments and group projects. In the projects, groups of students will be immersed in collecting, analyzing, and interpreting financial big data sets. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 471. Applications in Financial Big Data. 3 Units.
This course is project-based and focused on solving real-life problems using financial big data. Groups of students will collect/use data, estimate parameters, and conduct appropriate validation tests. Not only do the members have to work together, but they also have to be professional, make interim reports, and communicate effectively with each other. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 480. Global Banking & Capital Markets. 3 Units.
This course will expose students to Banking and Capital Market Structure, Practices, and Regulations in North America, Europe, as well as Asia. Students will learn about structure of the financial services industry in different parts of the world, the history and evolution of the regulatory frameworks in this industry, and its consequent impact on financial and economic development as well as risk. Several case studies are used to expose students to different issues and questions that arise in the day-to-day jobs of financial managers in this industry. Offered as BAFI 480 and MSFI 480. Prereq: For MSF-MSM and ACL-MSF students only.

MSFI 490. Projects in Corporate Finance. 3 Units.
This course is focused on engaging groups of students in identifying, analyzing and making decisions on real-world corporate financial problems. Teams of students will be assigned to a specific client situation drawn from one of three general areas: (i) mergers and acquisitions (involving corporations and/or leveraged buyout firms), (ii) public equities (IPOs and/or equity research) and (iii) corporate financial policies and transactions. This course is structured to be a capstone experience that allows students to leverage the broad range of skills, tools and approaches introduced throughout the program. It is intended to provide an important bridge from work in the classroom to the unstructured, chaotic nature of real world business. Prereq: For MSF-MSM and ACL-MSF students only.
MSFI 491. Projects in Risk Management. 3 Units.
This course is focused on engaging groups of students in identifying, analyzing and making decisions on real-world risk management financial problems. Teams of students will be assigned to a specific client situation drawn from one of two general areas: (i) investments and hedge funds, equity and portfolio management, fixed income and foreign exchange and (ii) risk management with derivatives, credit risk management, risk analytics, regulatory capital, asset liability bank management. This course is structured to be a capstone experience that allows students to leverage the broad range of skills, tools and approaches introduced throughout the program. It is intended to provide an important bridge from work in the classroom to the unstructured, chaotic nature of real world business. Prereq: For MSF-MSM and ACL-MSF students only.

MSOR Courses
MSOR 400. Linear Algebra. 1 Unit.
The objective of this one-credit hour course is to provide a basic working knowledge of material in linear algebra that is relevant to the MSM-OR/SC and MSM-BA programs. This background material includes geometric and algebraic properties of vectors and matrices together with operations that can be performed on them. The use of vectors and matrices in solving systems of linear equations is taught. Offered as MSOR 400 and MSBA 400. Prereq: For ORSC-MSM students only.

MSOR 402. Stochastic Models with Applications. 1.5 Unit.
This course surveys fundamental methods and models in operations research and operations management that incorporate random elements. Topics discussed will include basic results from the theory of stochastic processes, especially Markov chains; an introduction to stochastic dynamic programming; and models in the control of queues and inventories. Offered as OPRE 402 and MSOR 402. Prereq: For ORSC-MSM students only.

MSOR 406. Operations Management. 3 Units.
Operations managers, ranging from supervisors to vice presidents, are concerned with the production of goods and services. More specifically, they are responsible for designing, running, controlling and improving the systems that accomplish production. This course is a broad-spectrum course with emphasis on techniques helpful to the practice of management at the analyst level. Its goal is to introduce you to the environments, to help you appreciate the problems that operations managers are confronted with, and provide you with the tools to address these problems. Operations Management spans all value-adding activities of an organization including product and process design, production, service delivery, distribution network and customer order management. As global competition in both goods and services increases, a firm’s survival depends upon how well it structures its operations to respond quickly to changing consumer needs. Thus, it is essential for all business managers to acquire an understanding of operations management to maintain their competitive advantage. This course provides students with the basic tools needed to become an analyst in Supply Chain and Operations Management. This course provides an overview of Process analysis, Capacity management, Queuing system, analysis, Forecasting, Quality management, Material Requirements planning, Inventory management, and Supply Chain management. The emphasis of the course is on both real world applications and technical problem solving. Several manufacturing and non-manufacturing environments will be discussed explicitly, like health care, insurance, hotel-management, airlines and government related operations. Also we will explore the interface of operations management with other functional areas such as marketing, finance, accounting, etc. This coursework includes individual and group assignments, case analyses and experiential learning through simulations and educational games. Offered as: MSOR 406 and MSBA 406. Prereq: Course limited to students in Program=OPRMS, Plan=ORSC-MSM.

MSOR 407. Managerial Marketing. 3 Units.
This course will emphasize how to analyze data to support and guide strategic and tactical marketing decisions relevant for supply chain managers for understanding and contributing to marketing decision-making within the firm. Many firms have extensive information, but far fewer have the expertise to act intelligently on such information. Data must be synthesized, analyzed, and interpreted before sound marketing strategies and tactical plans can be developed. The course will emphasize three key themes: (1) Market Opportunity Analysis including competitive analysis, context assessment, and customer analytics (e.g. customer profitability and lifetime value, retention and loyalty), (2) Marketing Mix Analytics including test marketing, pricing, segmentation, and response modeling, and (3) Marketing ROI including the impact of marketing decisions and plans on fundamental financial measures such as return on marketing investment and net contribution to profit. The course uses a combination of lectures, cases, and exercises. Prereq: For students only in the MSM-OR/SC program.
MSOR 410. Accounting and Financial Management. 3 Units.
This course focuses on learning the language of business, how basic accounting information is reported and analyzed, and how basic financial principles can be applied to understanding how value is created within an enterprise. This course is intended for individuals who have a limited background in accounting, finance and business. Most of the exercises will involve evaluating and building models in Excel. Teaching objectives are fairly straightforward: 1. Provide you with a basic understanding of the key principles of accounting and finance. We will quickly cover material that is typically covered in a three-course sequence (Introductory Accounting and Finance I and II). We will fly at a fairly high level, but we want to make sure you understand the basic concepts. 2. Apply these concepts to real (but straightforward) business situations, to gain a better understanding of how companies utilize accounting and financial information. 3. Time permitting, explore how these concepts can be applied to securities, mergers and acquisitions and leveraged buyout transactions, with a specific emphasis on how these concepts are likely to surface in your role in such transactions. Offered as MSBA 410 and MSOR 410. Prereq: Course limited to students in Program=OPRMS, Plan=ORSC-MSM.

MSOR 411. Optimization Modeling. 3 Units.
The first half of the course provides a practical coverage of linear programming, a special type of mathematical model. The art of formulating linear programs is taught through the use of systematic model-building techniques. The simplex algorithm for solving these models is developed from several points of view: geometric, conceptual, algebraic, and economic. The role and uses of duality theory are also presented. Students learn to obtain and interpret a solution from a computer package and how to use the associated output to answer "What-happens-if..." questions that arise in post-optimality analysis. Specific topics include: problem formulation, geometric and conceptual solution procedures, the simplex algorithm (phase 1 and phase 2), obtaining and interpreting computer output, duality theory, and sensitivity analysis. The second half of this course provide a practical approach to formulating and solving combinatorial optimization problems in the areas of networks, dynamic programming, project management (CPM), integer programming, and nonlinear programming. The art of formulating problems, understanding what is involved in solving them, and obtained and interpreting the solution from a computer package are shown. A comparison with formulating and solving linear programming problems is provided as a way to understand the advantages and disadvantages of some of these problems and solutions procedures. Recommended preparation: Knowledge of Excel, one semester each of undergraduate linear algebra and undergraduate calculus (derivatives); or consent of instructor. Offered as MSOR 411 and OPRE 411. Prereq: For ORSC-MSM students only.

MSOR 420. Six Sigma and Quality Management. 3 Units.
The Six Sigma process is the standard for quality improvement in organizations around the globe. In this course, we study the details of the five steps in the Six Sigma process: DEFINE, MEASURE, ANALYZE, IMPROVE, and CONTROL (DMAIC). Many tools, concepts, and processes that are often an integral part of Six Sigma projects in companies are included in the course content. They range from the very basic tools of quality (such as cause-and-effect diagrams for brainstorming) to complete processes (such as benchmarking, quality function deployment, failure mode and effects analysis-FMEA). Statistical concepts with software applications that are central to Six Sigma including statistical process control and introduction to design of experiments are also included. Once the Six Sigma process and its various components are understood, we study quality management including quality control, quality planning, quality improvement, strategic quality management, and quality strategy. A major requirement of the course is an action learning component in which the students are assigned in groups to work on unpaid real projects of Six Sigma in local industries. Students meeting the required standards of performance will earn a Green Belt Certification in Six Sigma and Quality Management from the Weatherhead School of Management. Offered as MSOR 420 and OPMT 420. Prereq: MSOR 406 and MSOR 433 and enrolled in OPRMS Program/ORSC-MSM Plan or requisites not met permission.

MSOR 422. Lean Operations. 3 Units.
In this course, students will be taught how to identify inefficiencies associated with overproduction, waiting, transport, extra processing, inventory, motion and defects. One-by-one, areas of inefficiencies are to be identified and improved while educating the workforce towards continual improvement. Similarly, participants will be trained to reduce lead times in areas such as engineering design, order entry, purchasing, order fulfillment, receiving, production, packaging, shipping, invoicing and collection. The above improvements will lead to cost reductions. Students will be trained in costing techniques, target pricing, and cost maintenance. The course will be delivered along the following themes: 1) Mapping the Value Stream (current and future state) 2) Workplace Organization: SS & Safety, 3) Defect Reduction and Error Proofing, 4) Quick Changeover, 5) Standard Operations, 6) Total Productive Maintenance, 7) Visual management, 8) One-piece flow, 9) Lean Metrics. This course is not oriented toward specialists in operations management. Its goal is to introduce you to the environments and help you appreciate the problems that operations managers are confronted with and the key issues in their management. Offered as MSOR 422 and OPMT 422. Prereq: For ORSC-MSM students only.

MSOR 432. Computer Simulation. 3 Units.
Computer Simulation is a process of designing and creating a computerized model that mimics an existing or proposed system so as to better understand the behavior of the system. Many studies have shown that in Industry, simulation is most frequently used Operations Research tool due to its ability to deal with complex systems. The first half of this course is designed to give students a basic idea of simulation methodology with the aid of population simulation software. The emphasis of the course is in simulating business processes, however, the versatility of the technique will be demonstrated with applications from finance, health care, etc. The second half of the course covers the statistical design and analysis of simulation models. The topics include random number generation, input data analysis, statistical analysis of simulation outputs, variance reduction techniques, and design of simulation experiments. Offered as OPRE 332, OPRE 432, and MSOR 432. Prereq: For ORSC-MSM students only.
MSOR 433. Foundations of Probability and Statistics. 3 Units.
Data of many kinds are typically available in practice, but the challenge is to use those data to make effective professional decisions. This software-intensive course begins with useful descriptions of data and the probability theory foundation on which statistics rests. It continues to statistics, including the central limit theorem, which explains why data often appear to be normally distributed, and the Palm-Khintchine theorem which explains why data often appear to have a Poisson distribution. The remainder of the course focuses on regression and forecasting, including detecting and overcoming some of the deadly sins of regression, and the surprising flexibility of regression models. Recommended preparation: One semester of undergraduate calculus or consent of instructor. Offered as MSOR 433, OPRE 433 and MSBA 433. Prereq: For ORSC-MSM students only.

MSOR 435B. Integrated Problem Solving in OR and SC. 1.5 Unit.
This project-oriented course uses a variety of software to involve the student in the complete problem-solving process in OR and OM. This process includes problem definition and formulation, data collection, and storage in a database, connecting the database to the solution algorithm, designing and implementing an appropriate user interface, and presenting the final solution. Offered as OPRE 435B and MSOR 435B. Prereq: For ORSC-MSM students only.

MSOR 450. Project Management. 3 Units.
Project management is concerned with the management and control of a group of interrelated tasks required to be completed in an efficient and timely manner for the successful accomplishment of the objectives of the project. Since each project is usually unique in terms of task structure, risk characteristics and objectives, the management of projects is significantly different from the management of repetitive processes designed to produce a series of similar products or outputs. Large-scale projects are characterized by a significant commitment of organizational and economic resources coupled with a high degree of uncertainty. The objective of this course is to enhance the ability of participants to respond to the challenges of large-scale projects so that they can be more effective as project managers. We study in detail up-to-date concepts, models, and techniques useful for the evaluation, analysis, management, and control of projects. Offered as MSOR 450, OPMT 350 and OPMT 450. Coreq: MSOR 433 or requisites not met permission.

MSOR 451. Project Quality Management. 3 Units.
This course examines various methods used to ensure the project meets the stakeholder needs for which it was undertaken, including quality planning, quality assurance, and quality control. The coursework integrates the project requirements with the project plan, the reporting of its performance, and marking its closure. The Project Planning Process clarifies the project’s objectives and plans as well as all of the activities necessary in order to meet the project’s objectives and scope. It includes the Change Management Plan, Communications Management Plan, Configuration Management Plan, Cost Management Plan, Human Resource Plan such as roles charts, how resources will be acquired, time when each resource will be needed and any specialized training requirements. Project assurance includes the processes that ensure continual project improvement and learning throughout the organization. It includes the steps for analyzing processes with the purpose of improving the process by setting boundaries, process configuration, process metrics and targets for improved performance. Continuous improvement in projects requires determining Relationship Management, Requirements Management, Risk Management and Scope Management Plans. By having a customer management plan you and your customer can have a proven approach to the relationship. Requirements and Risk management plans are necessary to ensure project success as changes take place during the project lifetime. And Scope Management Plans are needs to align scope expectations with project success. The Project Control Group includes the processes to ensure that the project is managed and executed according to the Project Plan. Project Controlling includes tracking, reviewing and managing the progress and performance of the project along with managing changes when required. The use of Project Status Reports and Root Cause Analysis help identify and resolve problems during project execution. Upon project completion, the Project Closing Process group consists of the processes to formally closeout the project. Once the closing process is completed the project manager receives acceptance from the project sponsor, conducts a post project review, documents the lessons learned and archives all project related documents. A Post-project Review provides a 30,000 feet view of the projects; actual versus planned performance and is meaningful input to future projects. Offered as OPMT 451 and MSOR 451.

MSOR 475. Supply Chain Logistics. 3 Units.
The focus of this course is on the effective management of a firm's downstream processes in the supply chain that deliver goods and services to customers. Concepts, methods, and strategies are presented that can lower supply chain costs while maintaining or improving customer service. In addition, ideas for using the supply chain for competitive advantage leading to revenue enhancement are discussed. Adding value for customers is the objective. Key topics include transportation planning, inventory management, network design, and customer service goal setting. Offered as MSOR 475 and OPMT 475. Prereq: MSOR 406 and MSOR 433 and enrolled in OPRMS Program/ORSC-MSM Plan or requisites not met permission.

MSOR 476. Strategic Sourcing. 3 Units.
The primary purpose of the course is to provide a comprehensive introduction to supply issues in manufacturing and service organizations. Procurement and supply management has evolved as a strategic function across various industries. Recent volatility in commodity prices has further enhanced the challenges in procurement. This course explores sourcing strategies in global supply chains to reduce cost and enhance the competitiveness of the firm. This course will provide you with a framework for thinking about strategic sourcing and tools to procure commodities and services efficiently. Offered as MSOR 476 and OPMT 476. Prereq: For students in OPRMS Program/ORSC-MSM plan.
MSOR 477. Enterprise Resource Planning in the Supply Chain. 3 Units.
Enterprise resource planning is the dominant system by which companies translate the needs from their customers into the detailed plans that the company must perform to meet the customer needs, and the resulting support the company will need from its suppliers. As such, it is a central player in the process of supply chain management. In this course, we study both the quantitative and qualitative concepts and techniques to help manage a company's operations to perform these important translation and planning tasks in order to help the company be successful. The quantitative analysis will be supported by microcomputer software available in the Weatherhead computer lab. Student teams complete a series of integrated case studies from the same company to vividly see the relationships between various planning and control activities. A major emphasis during the course is the design of processes and procedures (algorithms) for solving very complex (wicked) problems as a part of both class discussions and while working on case studies, as well as critiquing the designs so as to clearly understand their limitations. Offered as MSOR 477, OPMT 377 and OPMT 477. Prereq: MSOR 411 and MSOR 433 and enrolled in OPRMS Program/ORSC-MSM Plan or requisites not met permission.

MSOR 485A. Individual Development. 1.5 Unit.
This course is unique in the sense that its primary focus is on the student as an individual. In this course the student will get to know themselves better by completing assessments and making sense of them, having group discussions, presenting to a group as individuals, engaging in various experiential activities, conducting career interviews, attending various individual development programs and participating in two individual coaching sessions. Offered as: MSOR 485A and MSBA 485A. Prereq: For ORSC-MSM students only.

MSOR 485B. Team Development. 1.5 Unit.
This course is unique in the sense that its primary focus is on the student working in teams. In this course the student will assess their team interaction based on team assignments simulated and action learning type projects, presenting to the class as a team, engaging in various experiential activities, participating one team coaching session, working with a team, and expanding their knowledge of team leadership and membership skills and abilities. They are also expected to engage with projects external to the university (similar to an action learning project). Offered as: MSOR 485B and MSBA 485B. Prereq: For ORSC-MSM students only.

MSOR 492. Scientific Python Programming with Applications. 0 Unit.
Python is a popular programming language and is used by all sorts of companies. It has many advantages: it is free, easy to learn, fast to learn and very versatile. This course will teach you how to read, write and understand Python scripts. You will learn good coding conventions, and be introduced to relevant resources and tools. We will move past the basics of procedural programming and explore how we can use the Python built-in data structures such as lists, dictionaries, and tuples to perform increasingly complex data analysis and we will utilize many libraries to do advanced scientific analysis, as well as data structuring and data analysis. Offered as MSOR 492 and BAFI 492. Prereq: MSOR 435B.

OPMT Courses
OPMT 350. Project Management. 3 Units.
Project management is concerned with the management and control of a group of interrelated tasks required to be completed in an efficient and timely manner for the successful accomplishment of the objectives of the project. Since each project is usually unique in terms of task structure, risk characteristics and objectives, the management of projects is significantly different from the management of repetitive processes designed to produce a series of similar products or outputs. Large-scale projects are characterized by a significant commitment of organizational and economic resources coupled with a high degree of uncertainty. The objective of this course is to enhance the ability of participants to respond to the challenges of large-scale projects so that they can be more effective as project managers. We study in detail up-to-date concepts, models, and techniques useful for the evaluation, analysis, management, and control of projects. Offered as MSOR 450, OPMT 350 and OPMT 450.

OPMT 377. Enterprise Resource Planning in the Supply Chain. 3 Units.
Enterprise resource planning is the dominant system by which companies translate the needs from their customers into the detailed plans that the company must perform to meet the customer needs, and the resulting support the company will need from its suppliers. As such, it is a central player in the process of supply chain management. In this course, we study both the quantitative and qualitative concepts and techniques to help manage a company's operations to perform these important translation and planning tasks in order to help the company be successful. The quantitative analysis will be supported by microcomputer software available in the Weatherhead computer lab. Student teams complete a series of integrated case studies from the same company to vividly see the relationships between various planning and control activities. A major emphasis during the course is the design of processes and procedures (algorithms) for solving very complex (wicked) problems as a part of both class discussions and while working on case studies, as well as critiquing the designs so as to clearly understand their limitations. Offered as MSOR 477, OPMT 377 and OPMT 477. Prereq: OPRE 207 and OPRE 301.

OPMT 412. Lean Services Operations. 3 Units.
The course will be delivered over four modules: 1) Service Process Blueprints, 2) Managing Capacity in Service Systems, 3) Mapping the Value Stream (current and future state), and 4) Inventory Management in Service Systems. The topics considered are viewed in the context of healthcare management, financial services, insurance firms, call centers, back-office operations, and other applications. Through these topics, the participants will be trained in tools that help them understand customers' expectations and needs and to identify service system characteristics that can meet these needs. We will learn how to identify errors in service and troubleshoot these problems by identifying the root causes of errors. Subsequently, we will discuss how one can modify the product or service design so as to prevent defects from occurring. Finally, we will establish performance metrics that help evaluate the effectiveness of the Lean system in place. These efforts will result to improved quality. This course is not oriented toward specialists in service management. Its goal is to introduce you to the environments and help you appreciate the problems that operations managers are confronted with. Then, we will typically discuss some system specifics and emphasize the principles and issues that play key role in their management. Offered as HSMC 412 and OPMT 412.
OPMT 420. Six Sigma and Quality Management. 3 Units.
The Six Sigma process is the standard for quality improvement in organizations around the globe. In this course, we study the details of the five steps in the Six Sigma process: DEFINE, MEASURE, ANALYZE, IMPROVE, and CONTROL (DMAIC). Many tools, concepts, and processes that are often an integral part of Six Sigma projects in companies are included in the course content. They range from the very basic tools of quality (such as cause-and-effect diagrams for brainstorming) to complete processes (such as benchmarking, quality function deployment, failure mode and effects analysis-FMEA). Statistical concepts with software applications that are central to Six Sigma including statistical process control and introduction to design of experiments are also included. Once the Six Sigma process and its various components are understood, we study quality management including quality control, quality planning, quality improvement, strategic quality management, and quality strategy. A major requirement of the course is an action learning component in which the students are assigned in groups to work on unpaid real projects of Six Sigma in local industries. Students meeting the required standards of performance will earn a Green Belt Certification in Six Sigma and Quality Management from the Weatherhead School of Management. Offered as MSOR 420 and OPMT 420. Prereq: (MSOR 406 or MBAP 408 or MBAC 507) and (MSOR 433 or OPRE 433 or MBAC 511 or MBAP 403) or Requisites Not Met permission.

OPMT 422. Lean Operations. 3 Units.
In this course, students will be taught how to identify inefficiencies associated with overproduction, waiting, transport, extra processing, inventory, motion and defects. One-by-one, areas of inefficiencies are to be identified and improved while educating the workforce towards continual improvement. Similarly, participants will be trained to reduce lead times in areas such as engineering design, order entry, purchasing, order fulfillment, receiving, production, packaging, shipping, invoicing and collection. The above improvements will lead to cost reductions. Students will be trained in costing techniques, target pricing, and cost maintenance. The course will be delivered along the following themes: 1) Mapping the Value Stream (current and future state) 2) Workplace Organization: SS & Safety, 3) Defect Reduction and Error Proofing, 4) Quick Changeover, 5) Standard Operations, 6) Total Productive Maintenance, 7) Visual management, 8) One-piece flow, 9) Lean Metrics. This course is not oriented toward specialists in operations management. Its goal is to introduce you to the environments and help you appreciate the problems that operations managers are confronted with and the key issues in their management. Offered as MSOR 422 and OPMT 422. Prereq: Not available to ORSC-MSM students.

OPMT 430. Sustainable Operations. 3 Units.
This course takes a business approach to environmental and social issues to answer "what do I need to know about environmental and social issues to make my company more successful, and how can I act on that knowledge profitably?" We summarize important environmental and social issues facing business (and all of society), such as global climate change, pollution, economic development, hunger, and social unrest. Drawing on most areas of the MBA program, we examine environmental and social issues associated with product design and component commonality, recycling materials, product packaging, process design and remanufacturing, facility location and design (including green building), reverse logistics and closed-loop supply chains, and global supply chains.

OPMT 450. Project Management. 3 Units.
Project management is concerned with the management and control of a group of interrelated tasks required to be completed in an efficient and timely manner for the successful accomplishment of the objectives of the project. Since each project is usually unique in terms of task structure, risk characteristics and objectives, the management of projects is significantly different from the management of repetitive processes designed to produce a series of similar products or outputs. Large-scale projects are characterized by a significant commitment of organizational and economic resources coupled with a high degree of uncertainty. The objective of this course is to enhance the ability of participants to respond to the challenges of large-scale projects so that they can be more effective as project managers. We study in detail up-to-date concepts, models, and techniques useful for the evaluation, analysis, management, and control of projects. Offered as MSOR 450, OPMT 350 and OPMT 450. Coreq: MSOR 433 or MBAC 511 or MBAP 403 or requisites not met permission.

OPMT 451. Project Quality Management. 3 Units.
This course examines various methods used to ensure the project meets the stakeholder needs for which it was undertaken, including quality planning, quality assurance, and quality control. The coursework integrates the project requirements with the project plan, the reporting of its performance, and marking its closure. The Project Planning Process clarifies the project's objectives and plans as well as all of the activities necessary in order to meet the project's objectives and scope. It includes the Change Management Plan, Communications Management Plan, Configuration Management Plan, Cost Management Plan, Human Resource Plan such as roles charts, how resources will be acquired, time when each resource will be needed and any specialized training requirements. Project assurance includes the processes that ensure continual project improvement and learning throughout the organization. It includes the steps for analyzing processes with the purpose of improving the process by setting boundaries, process configuration, process metrics and targets for improved performance. Continuous improvement in projects requires determining Relationship Management, Requirements Management, Risk Management and Scope Management Plans. By having a customer management plan you and your customer can have a proven approach to the relationship. Requirements and Risk management plans are necessary to ensure project success as changes take place during the project lifetime. And Scope Management Plans are needs to align scope expectations with project success. The Project Control Group includes the processes to ensure that the project is managed and executed according to the Project Plan. Project Controlling includes tracking, reviewing and managing the progress and performance of the project along with managing changes when required. The use of Project Status Reports and Root Cause Analysis help identify and resolve problems during project execution. Upon project completion, the Project Closing Process group consists of the processes to formally closeout the project. Once the closing process is completed the project manager receives acceptance from the project sponsor, conducts a post project review, documents the lessons learned and archives all project related documents. A Post-project Review provides a 30,000 feet view of the projects; actual versus planned performance and is meaningful input to future projects. Offered as OPMT 451 and MSOR 451.
OPMT 475. Supply Chain Logistics. 3 Units.
The focus of this course is on the effective management of a firm's downstream processes in the supply chain that deliver goods and services to customers. Concepts, methods, and strategies are presented that can lower supply chain costs while maintaining or improving customer service. In addition, ideas for using the supply chain for competitive advantage leading to revenue enhancement are discussed. Adding value for customers is the objective. Key topics include transportation planning, inventory management, network design, and customer service goal setting. Offered as MSOR 475 and OPMT 475. Prereq: (MSOR 406 or MBAP 408 or MBAC 507) and (MSOR 433 or OPRE 433 or MBAC 511 or MBAP 403) or requisites not met permission.

OPMT 476. Strategic Sourcing. 3 Units.
The primary purpose of the course is to provide a comprehensive introduction to supply issues in manufacturing and service organizations. Procurement and supply management has evolved as a strategic function across various industries. Recent volatility in commodity prices has further enhanced the challenges in procurement. This course explores sourcing strategies in global supply chains to reduce cost and enhance the competitiveness of the firm. This course will provide you with a framework for thinking about strategic sourcing and tools to procure commodities and services efficiently. Offered as MSOR 476 and OPMT 476. Prereq: Not available to Operations Research MSM students.

OPMT 477. Enterprise Resource Planning in the Supply Chain. 3 Units.
Enterprise resource planning is the dominant system by which companies translate the needs from their customers into the detailed plans that the company must perform to meet the customer needs, and the resulting support the company will need from its suppliers. As such, it is a central player in the process of supply chain management. In this course, we study both the quantitative and qualitative concepts and techniques to help manage a company's operations to perform these important translation and planning tasks in order to help the company be successful. The quantitative analysis will be supported by microcomputer software available in the Weatherhead computer lab. Student teams complete a series of integrated case studies from the same company to vividly see the relationships between various planning and control activities. A major emphasis during the course is the design of processes and procedures (algorithms) for solving very complex (wicked) problems as a part of both class discussions and while working on case studies, as well as critiquing the designs so as to clearly understand their limitations. Offered as MSOR 477, OPMT 377 and OPMT 477. Prereq: MBAC 511 or MBAP 403 or requisites not met permission.

OPMT 490. Independent Study in Operations Management. 1 - 15 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

OPMT 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

OPRE Courses

OPRE 207. Statistics for Business and Management Science I. 3 Units.

OPRE 301. Operations Research and Supply Chain Management. 3 Units.
Operations research (OR) or management science, is the discipline of applying advanced quantitative methods to make better decisions. Techniques covered include linear programming, queuing models and simulation. The second part of the course focuses on how OR tools are used in managing various aspects of Supply Chain. Topics covered include demand forecasting, design of distribution systems, capacity planning, and inventory management. Recommended preparation: one semester of statistics or consent of instructor. Prereq: STAT 207 or OPRE 207.

OPRE 332. Computer Simulation. 3 Units.
Computer Simulation is a process of designing and creating a computerized model that mimics an existing or proposed system so as to better understand the behavior of the system. Many studies have shown that in Industry, simulation is most frequently used Operations Research tool due to its ability to deal with complex systems. The first half of this course is designed to give students a basic idea of simulation methodology with the aid of population simulation software. The emphasis of the course is in simulating business processes, however, the versatility of the technique will be demonstrated with applications from finance, health care, etc. The second half of the course covers the statistical design and analysis of simulation models. The topics include random number generation, input data analysis, statistical analysis of simulation outputs, variance reduction techniques, and design of simulation experiments. Offered as OPRE 332, OPRE 432, and MSOR 432. Prereq: OPRE 301.

OPRE 345. Decision Theory. 3 Units.
This course provides an understanding of the principles, basic concepts, and methodology of engineering economics. It develops proficiency with these methods and with the process for making rational decisions regarding situations likely to be encountered in professional practice.

OPRE 402. Stochastic Models with Applications. 1.5 Unit.
This course surveys fundamental methods and models in operations research and operations management that incorporate random elements. Topics discussed will include basic results from the theory of stochastic processes, especially Markov chains; an introduction to stochastic dynamic programming; and models in the control of queues and inventories. Offered as OPRE 402 and MSOR 402. Prereq: OPRE 433 or OPRE 433A and OPRE 433B.
OPRE 411. Optimization Modeling. 3 Units.
The first half of the course provides a practical coverage of linear programming, a special type of mathematical model. The art of formulating linear programs is taught through the use of systematic model-building techniques. The simplex algorithm for solving these models is developed from several points of view: geometric, conceptual, algebraic, and economic. The role and uses of duality theory are also presented. Students learn to obtain and interpret a solution from a computer package and how to use the associated output to answer "What-happens-if..." questions that arise in post-optimality analysis. Specific topics include: problem formulation, geometric and conceptual solution procedures, the simplex algorithm (phase 1 and phase 2), obtaining and interpreting computer output, duality theory, and sensitivity analysis. The second half of this course provide a practical approach to formulating and solving combinatorial optimization problems in the areas of networks, dynamic programming, project management (CPM), integer programming, and nonlinear programming. The art of formulating problems, understanding what is involved in solving them, and obtained and interpreting the solution from a computer package are shown. A comparison with formulating and solving linear programming problems is provided as a way to understand the advantages and disadvantages of some of these problems and solutions procedures. Recommended preparation: Knowledge of Excel, one semester each of undergraduate linear algebra and undergraduate calculus (derivatives); or consent of instructor. Offered as MSOR 411 and OPRE 411.

OPRE 427. Convexity and Optimization. 3 Units.
Introduction to the theory of convex sets and functions and to the extremes in problems in areas of mathematics where convexity plays a role. Among the topics discussed are basic properties of convex sets (extreme points, facial structure of polytopes), separation theorems, duality and polars, properties of convex functions, minima and maxima of convex functions over convex set, various optimization problems. Offered as MATH 327, MATH 427, and OPRE 427. Prereq: MATH 223 or consent of instructor.

OPRE 432. Computer Simulation. 3 Units.
Computer Simulation is a process of designing and creating a computerized model that mimics an existing or proposed system so as to better understand the behavior of the system. Many studies have shown that in Industry, simulation is most frequently used Operations Research tool due to its ability to deal with complex systems. The first half of this course is designed to give students a basic idea of simulation methodology with the aid of population simulation software. The emphasis of the course is in simulating business processes, however, the versatility of the technique will be demonstrated with applications from finance, health care, etc. The second half of the course covers the statistical design and analysis of simulation models. The topics include random number generation, input data analysis, statistical analysis of simulation outputs, variance reduction techniques, and design of simulation experiments. Offered as OPRE 332, OPRE 432, and MSOR 432. Prereq: Enrollment in a program other than MSM Operations Research.

OPRE 433. Foundations of Probability and Statistics. 3 Units.
Data of many kinds are typically available in practice, but the challenge is to use those data to make effective professional decisions. This software-intensive course begins with useful descriptions of data and the probability theory foundation on which statistics rests. It continues to statistics, including the central limit theorem, which explains why data often appear to be normally distributed, and the Palm-Khintchine theorem which explains why data often appear to have a Poisson distribution. The remainder of the course focuses on regression and forecasting, including detecting and overcoming some of the deadly sins of regression, and the surprising flexibility of regression models. Recommended preparation: One semester of undergraduate calculus or consent of instructor. Offered as MSOR 433, OPRE 433 and MSBA 433.

OPRE 435B. Integrated Problem Solving in OR and SC. 1.5 Unit.
This project-oriented course uses a variety of software to involve the student in the complete problem-solving process in OR and OM. This process includes problem definition and formulation, data collection, and storage in a database, connecting the database to the solution algorithm, designing and implementing an appropriate user interface, and presenting the final solution. Offered as OPRE 435B and MSOR 435B Prereq or Coreq: OPRE 411 or MSOR 411 or requisites not met permission.

OPRE 454. Analysis of Algorithms. 3 Units.
This course covers fundamental topics in algorithm design and analysis in depth. Amortized analysis, NP-completeness and reductions, dynamic programming, advanced graph algorithms, string algorithms, geometric algorithms, local search heuristics. Offered as EECS 454 and OPRE 454. Prereq: OPRE 435A and OPRE 435C.

This course is offered, with permission, to students undertaking reading in a field of special interest.

OPRE 501. Special Problems and Topics. 1 - 36 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

OPRE 701. Dissertation Ph.D.. 1 - 9 Units.
This course is limited to candidates for the Ph.D. degree who are preparing dissertations in some field of operations research. Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

ORBH Courses
ORBH 250. Leading People (LEAD I). 3 Units.
The principal goals of this course are to help students learn about the context in which managers and leaders function, gain self-awareness of their own leadership vision and values, understand the options they have for careers in management based on their own aptitudes, orientations and expertise, and develop the fundamental skills needed for success in a chosen career. Through a series of experiential activities, assessment exercises, group discussions, and peer coaching, based on a model of self-directed learning and life-long development, the course helps students understand and formulate their own career and life vision, assess their skills and abilities, and design a development plan to reach their objectives. The course enables students to see how the effective leadership of people contributes to organizational performance and the production of value, and how for many organizations, the effective leadership of people is the driver of competitive advantage. This is the first course in a two course sequence. Prereq: At least sophomore standing.
ORBH 251. Leading Organizations (LEAD II). 3 Units.
The principal goal of this course is to help students enhance their leadership skills by understanding how organizations function through the lenses of structure, culture, and power/politics. The course enables students to discern how leaders function effectively as they integrate goals, resources and people within these constraints. Students learn about these organizational lenses while developing their own leadership and professional skills. Prereq: ORBH 250 or ORBH 396 or MGMT 250 and at least sophomore standing.

ORBH 303. Leading Teams through Interpersonal Relationships. 3 Units.
This course is designed for students who want to increase their understanding of interpersonal and team dynamics. It is designed to help you to build more open and effective relationships and to improve your ability to cooperate with and lead others to work effectively in today’s increasingly team-oriented organizations. The emphasis of this course is on learning about oneself in the context of others based on the here-and-now experience of the group. Prereq: At least sophomore standing.

ORBH 360. Independent Study. 1 - 6 Units.
This course is set up individually upon conference between student and Organizational Behavior faculty member designed in consult with the student’s advisor if necessary in order to engage and challenge student with topics in organizational behavior.

ORBH 370. Women and Men as Colleagues in Organizations. 3 Units.
The purpose of this course is to prepare students to succeed in the workforce by understanding and exploring the opportunities and challenges of work across the lifespan and developing necessary skills to be effective. The course broadens understanding of gender dynamics and gendered structures in the workplace, intersections of gender with other identities, and the leadership and managerial issues affecting women and men in work organizations. The course helps students create a personal framework for how to develop a successful, happy and integrated work life in the global economy. Offered as ORBH 370 and WGST 370. Counts for CAS Global & Cultural Diversity Requirement.

ORBH 380. Managing Negotiations. 3 Units.
Negotiation is the art and science of securing agreements between two or more interdependent parties. Negotiation skills are critical to influencing others and thus to effective leadership. The good news is that negotiation is a skill that can be developed. In this interactive course, you will learn how to be a more effective negotiator by learning about the theory and processes of negotiation, participating in negotiation simulations, reflecting on your own and others’ negotiation experiences and completing assignments designed to help you hone your negotiation skills. This will be done through a variety of means, including: understanding the theory and processes of negotiation, participating in negotiation simulations, reflecting on your own and others’ negotiation experiences and completing assignments designed to help you hone your negotiation skills. Prereq: At least sophomore standing.

ORBH 391. Leadership in Diversity and Inclusion: Towards a Globally Inclusive Workplace. 3 Units.
This course addresses workforce diversity issues from individual, group, and organizational perspectives. The focus is on innovative ways of utilizing today’s culturally expanding workforce. Emphasis is on the “what and how” for managers in developing a corporate culture that embraces diversity, helping them in learning to work with, supervise and tap the talent of diverse employees within their organizations. Included are methods for modifying systems to attract, retain, develop, and capitalize on benefits of the new workforce demographics.

ORBH 396. Professional Development for Engineers. 3 Units.
The overall objective of this course is essentially to help you to learn, grow and change personally and professionally. The course is designed to develop your self-awareness, leadership capability, relationship and collaboration skills. Specific learning objectives are: 1. Develop greater self-awareness around your core values, personal vision, career aspirations, strengths and emotional intelligence. Deepening your self-knowledge and self-awareness on these dimensions is important for setting up your personal path to success. 2. Learn how people develop and grow through a process of intentional change. You will personally apply this insight and create a plan to achieve your learning and development goals. 3. Learn about and experience the impact of personal and peer coaching. Being able to develop, nurture and sustain positive developmental relationships at work is a hallmark of highly effective professionals. 4. Expand your capability to work effectively with a range of people in groups and teams. Understanding and practicing effective communication, giving and receiving feedback and appreciating differences in others are key factors in working well with others. Prereq: Case School of Engineering majors only.

ORBH 403. Developing Interpersonal Skills for Managers. 3 Units.
This course is intended to sharpen students’ skills in the art of relating successfully to other individuals and groups. The course uses an intensive group experience to make students more aware of how their actions affect others, more capable of giving and receiving interpersonal feedback, and more cognizant of processes through which groups work. Several Saturday classes.

ORBH 413. Economics of Negotiation and Conflict Resolution. 3 Units.
Students frequently enroll in a negotiation class with one thought in mind—negotiating a better job offer from an employer. They soon learn, however, that negotiation skills can do far more than improve a pay check. Negotiations occur everywhere: in marriages, in divorces, in small work teams, in large organizations, in getting a job, in losing a job, in deal making, in decision making, in board rooms, and in court rooms. The remarkable thing about negotiations is that, wherever they occur, they are governed by similar principles. The current wave of corporate restructuring makes the study of negotiations especially important for M.B.A.s. Mergers, acquisitions, downsizing and joint ventures call into question well established business and employment relationships. Navigating these choppy waters by building new relationships requires negotiation skills. The increased stress on quality and other hard-to-measure aspects of relationships with customers and suppliers makes the process of negotiation even more complex and subtle. For these reasons, negotiation classes have taken center stage in the study of management. Every major business school now offers classes in negotiation and these classes are overflowing with students. Offered as ECON 431 and ORBH 413.

ORBH 430A. MBA Institute In Sustainable Value and Social Entrepreneurship I. 3 Units.
The MBA Institute in Sustainability and Social Entrepreneurship involves 6 credits divided up into two “courses”. The first course—phase one—creates a foundational platform featuring key models and managerial tools for the building sustainable value and “turning the social and global issues of our day into business opportunities.” The second course in an applied sustainability field experience where teams work with companies and communities or real-life sustainability and social entrepreneurship opportunities. The foundations course is a prerequisite to the applied field project phase.
**ORBH 430B. MBA Practicum in Sustainable Value and Social Entrepreneurship II. 3 Units.**

The MBA Institute in Sustainability and Social Entrepreneurship involves 6 credits divided up into two "courses." The first course--phase one--creates a foundational platform featuring key models and managerial tools for the building sustainable value and "turning the social and global issues of our day into business opportunities." The second course is an applied sustainability field experience where teams work with companies and communities or real-life sustainability and social entrepreneurship opportunities. The foundations course is a pre-requisite to the applied field project phase. Prereq: ORBH 430A.

**ORBH 450. Executive Leadership. 3 Units.**

This course explores answers to questions such as: Who are leaders? Are they different than managers, heroes and heroines? How do the effective ones think and act? What situations create leaders, foster their emergence or provide opportunities? What makes us want to follow them? What are the personal pits of being a leader (i.e., sex, drugs, alcohol, insomnia, ulcers, etc.)? How are leaders developed? Case studies, self-study and at-work projects will be the primary methods used in the course.

**ORBH 451. Alternative Dispute Resolution. 3 Units.**

Students will examine the processes of alternative dispute resolution (ADR) through reading materials, videotapes, guest lectures, and simulation exercises. Particular emphasis will be given to the interaction of lawyers and clients in business negotiations and in litigation. Negotiation, arbitration, mediation, and the mini-trial will be examined. The class will also cover impediments to ADR, such as lack of understanding or hostility on the part of clients or lawyers.

**ORBH 460. Women in Organizations. 3 Units.**

This course addresses important leadership and management issues concerning women in organizations. The course provides complex understandings of issues pertinent to professional women and work such as sex role typing, sex-based discrimination, equal pay, sexual harassment, work-family balance, women's leadership and women's career issues and development. The course helps students increase self-knowledge about their own values and practices as well as enhance their capabilities as leaders and managers. We will examine the opportunities, challenges, trade-offs, and organizational dynamics experienced by women in work settings, as well as the interpersonal, organizational, and societal structures and processes impacting women in organizations. Through a variety of course methods, students gain greater awareness of the gendered nature of work and organizations and learn effective strategies for women's career progress and effective participation in organizations.

**ORBH 470A. Leading Change from a Complexity Perspective. 1 Unit.**

In this course, we will continuously attempt to answer two questions: (1) What is the process of sustained, desirable change? and (2) What is the role of a leader? Concepts from complexity theory will be used, including understanding the multilevel nature of SDC at the individual, dyad, team, organization, community, country, and global levels. Intentional Change Theory (ICT) will be used as the organizing concept for the changes studied. In this context, coaching the development of leadership will be a major topic throughout the course. Prereq: Open to MPOD candidates only.

**ORBH 470B. Leading Change from a Complexity Perspective. 2 Units.**

In this course, we will continuously attempt to answer two questions: (1) What is the process of sustained, desirable change? and (2) What is the role of a leader? Concepts from complexity theory will be used, including understanding the multilevel nature of SDC at the individual, dyad, team, organization, community, country, and global levels. Intentional Change Theory (ICT) will be used as the organizing concept for the changes studied. In this context, coaching the development of leadership will be a major topic throughout the course. Prereq: ORBH 470A.

**ORBH 491. Leadership in Diversity and Inclusion: Towards a Globally Inclusive Workplace. 3 Units.**

This course addresses workforce diversity issues from individual, group, and organizational perspectives. The focus is on innovative ways of utilizing today's culturally expanding workforce. Emphasis is on the "what and how" for managers in developing a corporate culture that embraces diversity, helping them in learning to work with, supervise and tap the talent of diverse employees within their organizations. Included are methods for modifying systems to attract, retain, develop, and capitalize on benefits of the new workforce demographics. A retreat experience is part of this course and is required of all participants.

**ORBH 501. Special Problems and Topics. 1 - 18 Units.**

This course is offered, with permission, to students undertaking reading in a field of special interest.

**ORBH 510. Organizational Behavior Department Seminar. 1.5 Unit.**

The OB Department Seminar is organized and managed by the first year PhD students. Seminar sessions will alternate between first year meetings and gatherings of the ORBH community of students, faculty and friends. Community sessions will be organized around research presentations of PhD Qualifying Papers, Dissertation Proposals and Dissertation Defense. Seminar Objectives: 1. To create and sustain an appreciative, intellectually nourishing learning space for the ORBH community that will support, inspire and empower us to explore the frontiers of scholarship in our field; 2. To provide a forum for sharing the ongoing research and scholarship of the department; 3. To develop productive collaborative research relationships; 4. To increase our collective knowledge of the current state of the art in OB and to develop productive collaborative research relationships; 4. To increase our collective knowledge of the current state of the art in OB and related fields.

**ORBH 511. Micro Organizational Behavior. 1.5 Unit.**

Examines the field of micro-organizational behavior. Specifically, the study of individuals and groups within an organizational context and the study of internal processes and practices as they affect individuals and groups. Major topics include individual characteristics such as beliefs, values and personality. Individual processes such as motivation, emotions, commitment, group and team processes, such as decision-making, organizational processes and practices such as goal setting, performance appraisal and rewards, and the influence of all of these on such individual, group and organizational outcomes as performance, job satisfaction, citizenship behaviors, turnover, justice, absenteeism and employee engagement.
ORBH 513. Appreciative Inquiry and Strength-Based Change. 1.5 Unit.
This course explores and develops the art of understanding social systems in ways that help us imagine, design and develop organization excellence. It seeks to show how many of our conventional ideas about organizations are based on discourse and metaphors that lead us to see and understand organizations in partial and often limiting ways. Growing research from the domains of Positive Psychology and Positive Organization Scholarship and the theory and practice of Appreciative Inquiry will be explored to show how we can create new and more positive, strength-based ways of designing and developing social systems.

ORBH 516. The Scholarship of Coaching. 1.5 Unit.
Coaching is a helping relationship in which one person assists another with change with respect to a person's behavior, attitudes, mental models, dreams of the future, etc. The popularity of the practice of coaching began to dramatically increase at least 20 years before scholars designed studies to test its efficacy. In this course, we will examine scholarly work in the coaching domain that has emerged. Prereq: Limited to ORBH PhD students only.

ORBH 520. Group and Interpersonal Analysis. 1.5 Unit.
This course is a review of major concepts and research in group dynamics and interpersonal relations. Topics include: face-to-face social interaction such as communication patterns, power, hierarchy, leadership, norms, goals, productivity, social theories of personality, and personal change through group methods. The course combines cognitive emphasis and personal experience-based learning.

ORBH 523. Design for Sustainable Value. 1.5 Unit.
The relationship between business and society—and the search for mutually beneficial advances between industry and the world's most pressing global issues—has become one of the defining issues of the 21st century. Throughout the world, immense entrepreneurial energy is finding expression, energy whose converging force is in direct proportion to the turbulence, crises, and the call of our times. Factories and buildings are being designed in ways that, surprisingly, give back more clean energy to the world than they use. Bottom-of-the-pyramid strategies and micro-enterprise models are demonstrating how business can eradicate poverty through profitability. Companies are designing products that leave behind no waste—only "food" that becomes input into their biological or technological cycles. And macrowinomics—everything from telepresence to megcommunity—is rebooting our capacity for human cooperation and global action. Prereq: Limited to ORBH PhD students only.

ORBH 525. Leading Change from a Complexity Perspective. 1.5 Unit.
Change is an enigma and yet sustained, desirable change (SDC) drivers adaptation, growth and life itself. In this course, we will continuously attempt to answer two questions: (1) What is the process of sustained, desirable change? and (2) What is the role of a leader, including their emotional and social intelligence? Concepts from complexity theory will be used, as well as case studies and longitudinal studies including understanding the multilevel nature of SDC at the individual, dyad, team, organization (including family business), community, country, and global levels. Intentional Change Theory (ICT) will be used as the organizing concept for the changes studied. Prereq: Limited to ORBH PhD students only.

ORBH 528. The Dynamics of Managing Effective Change. 1.5 Unit.
This course explores and develops an understanding of how individuals actually effect positive change and outcomes within an organization without the requisite authority or decision making power to do so. It seeks to show how managing a change process appears to follow a path of cumulative activities that in time produce a punctuated equilibrium— one that triggers a step up in performance. Such activities seem to be small episodes or learning cycles geared at converting inert knowledge into action; increasing awareness; reinforcing accountability, and/or attaining results. These findings will be compared and contrasted to existing change models and theories. Prereq: Limited to ORBH PhD students only.

ORBH 533. The Practice Turn in Organizational Research. 1.5 Unit.
In this course, doctoral students will develop an understanding of the role of practice and performativity in organizing. This involves exploring the link between doing and thinking by and between individuals in an effort to address larger issues of group- and organizational-level behavior. Students will examine elements of human behavior in organizational endeavors such as embodied cognition, and the enactment of structures and routines. Methods of "capturing" practice in organizing will also be discussed. By the end of the course, students will be expected to articulate how the practice perspective relates to their own research interests and future projects. Prereq: Limited to ORBH PhD students only.

ORBH 538. Research and Theory on Dynamical Behavior in Groups. 1.5 Unit.
This seminar exposes student to a variety of conversations in the study of group dynamics. Major topics include work on commons dilemmas, communal and exchange relationships, social facilitation, social loafing, social combination, and social creativity drawing deeply on our historical roots. It will also focus on current topical issues such as demographic faultlines, transactional memory, and issues of time and transition. Prereq: Limited to ORBH PhD students only.

ORBH 540. Social Exchange, Social Networks, and Social Capital in Organizations. 1.5 Unit.
In this course we will examine the nature of social exchange relationships in organizations. We will explore how individual perceptions regarding the quality of the relationship they have with their immediate supervisor, their work group, and the organization as an entity can impact their workplace attitudes and behaviors. Additionally, we will learn how the examination of networks of relationships can enhance our understanding of how individuals experience organizational life. The course will also provide a brief introduction to the theory, methods and procedures of social network analysis with an emphasis on applications to individual and organizational social capital.

ORBH 541. Organizational Systems. 1.5 Unit.
This course covers the use of general systems theory as a conceptual base for examining organizations from the macro-perspective. The course examines organizational structure and technology, organizations and interorganizational networks in interaction with their societal environments, and large-scale problems of organizational and social power, conflict and change. It is designed to present a large-scale perspective on organization theory and behavior that is complementary to the micro-perspective of organizational behavior.
Weatherhead School of Management Courses

ORBH 560. Research Methods I. 3 Units.
This course concerns itself with issues associated with the conduct of social research. The primary focus is on learning the "craft" of research and its associated technologies. Among the topics that are addressed are: scientific method; research terminology and definitions; search design; laboratory experiments; simulations; field experiments; field studies; measurement, reliability and validity; and sampling. This course is intended to help students acquire the skills necessary in undertaking dissertation-related research.

ORBH 565. Research in Gender and Diversity in Organizations. 1.5 Unit.
This course will provide a full range of feminist research methods exploring relationships between feminism and methodology involving a plurality of perspectives for conducting research and creating knowledge with an emphasis on collecting and interpreting qualitative materials. Particular attention is paid to understanding gender and diversity related phenomenon that occurs in the workplace. Classic feminist research from a variety of historical, societal, economic, interpersonal and organizational paradigms are incorporated. Coreq: ORBH doctoral students only.

ORBH 570. Learning and Development. 1.5 Unit.
This course provides an exploration of the learning and development paradigm underlying the human potential development approach to human resource development. The origins of this approach in the naturalist epistemologies John Dewey's pragmatism, Kurt Lewin's gestalt psychology, the work of James, Follett, Emerson, Piaget, Maslow, Rogers, and others and current research in adult development, biology and brain/mind research, artificial intelligence, epistemology, moral philosophy and adult learning will be considered. The course will focus on applications of these ideas to current issues in human resource development such as adult learning in higher education, advanced professional development, and large system learning and development. Coreq: ORBH doctoral students only.

ORBH 601. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to candidates undertaking reading in a field of special interest.

ORBH 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

PLCY Courses

PLCY 399. Business Policy. 3 Units.
This course uses case analysis to develop perspective and judgment on business problems through the integration of functional areas. Formulation, development, and implementation of organization goals and policies, the development of strategy in relation to the competitive environment, and applications of quantitative and behavioral decision-making techniques are examined. Prereq: Senior standing.

PLCY 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.

PLCY 701. Dissertation Ph.D.. 1 - 9 Units.
Prereq: Predoctoral research consent or advanced to Ph.D. candidacy milestone.

QUMM Courses

QUMM 414. Statistics and Decision Modeling. 3 Units.
This course provides the foundations of statistical and operations research methodologies for managerial decision-making. Business statistics focuses on statistical thinking as one of the fundamentals of effective management. Topics covered include sampling and the normal distribution, making inferences from data via confidence intervals and hypothesis tests, and analyzing relationships between samples. Decision modeling of organizational systems uses mathematical and computer models to provide a quantitative perspective on identifying, analyzing and solving complex decision problems. This course includes an introduction to linear programming models and applications, simulation techniques in decision-making, and project management.

QUMM 501. Special Problems and Topics. 1 - 18 Units.
This course is offered, with permission, to students undertaking reading in a field of special interest.
SCHOOL OF GRADUATE STUDIES

The Case Western Reserve University School of Graduate Studies (http://case.edu/gradstudies) (SGS) is the unit through which Case Western Reserve University offers graduate programs in the humanities and social sciences, biomedical and natural sciences, engineering, and selected disciplines related to professional fields. These programs lead to the degrees of Master of Arts, Master of Fine Arts (theater and dance), Master of Science, Master of Public Health, Master of Engineering and Management, Master of Engineering, Master of Science in Anesthesia, Doctor of Musical Arts, and Doctor of Philosophy. Several programs offered jointly with the professional schools and local affiliated institutions lead to dual degrees such as MA/MD, MA/PhD, MA/MS, MS/MBA, MS/MED, MS/MPH, MSSA/PhD, PhD/MPH, JD/MPH, MSN/MPH, MBA/MPH, MD/MPH, MPH/MA, and MD/PhD. There are also three combined undergraduate and graduate programs, IGS (Integrated Graduate Studies), BS/MS, and BS/ME, which allow undergraduate students to enter graduate study before they complete their undergraduate programs. A complete list of degree programs offered can be found on the Graduate Studies website (http://case.edu/gradstudies). The School of Graduate Studies, overseeing university-wide standards of quality in admission and performance, presently awards graduate degrees in seventy-two departments: fifty-two with PhD programs and twenty others in which the highest degree is the MA, ME, MEM, MFA, MPH, MS, MSA, or DMA. Enrollment in the School of Graduate Studies for fall 2014, excluding non-degree registrants, totaled 2317, of which 51.5% were men, 48.4% were women, and 29.7% were international. During the academic year 2013-2014, the school awarded 500 master’s degrees and 186 doctorates.

Administration of the School

Charles E. Rozek, PhD
(Wayne State University)
Vice Provost and Dean of Graduate Studies

Lynmarie Hamel, JD, M.Ed.
(Case Western Reserve University)
Senior Associate Dean of Graduate Studies

Faculty Senate Committee on Graduate Studies

General responsibility for overseeing postdoctoral affairs, programs of graduate study and for academic and other general regulations applicable to all graduate students and programs is delegated to the Faculty Senate Committee on Graduate Studies (http://case.edu/facultysenate/about/committees-panels/committee-on-graduate-studies). Each department, school, or interdisciplinary committee is responsible for its particular graduate programs within the framework of the general regulations. The Committee on Graduate Studies consists of the dean of graduate studies, the associate vice president for research, nine faculty members elected by the University Faculty Senate, one appointed postdoc and four graduate students – three elected by the Graduate Student Council and one appointed from the professional schools.

Graduate Student Council

All graduate and professional students at CWRU are represented by a Graduate Student Council (GSC). Representatives are elected from each school or college that offers graduate programs as outlined in its constitution. The constitution and bylaws of the GSC are published on their site. (http://gsc.case.edu)

School of Graduate Studies Programs of Study

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Biomedical Sciences

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School of Graduate Studies Academic Policies

Graduate Academic Policies

Fellowship Tuition Policy for Graduate Students
The purpose of this policy is to allow students pursuing graduate degrees to take courses beyond their degree requirements without additional financial burden to the student and little or no cost to the university. Such courses, referred to as “fellowship” courses, can broaden the educational experience of graduate students by allowing them to pursue studies according to their own intellectual needs.

1. A student pursuing a graduate degree shall be charged tuition at the standard hourly rate for all of the credit hours which are intended to count toward the degree. In the fall and spring semesters for which students are registered for a minimum number (as determined by the school) of credits that will be applied toward the degree, fellowship courses will not incur a tuition charge. In the summer semester, there is no minimum registration required to qualify for the fellowship tuition policy.

2. In order to enroll in a fellowship course, the student must be in good standing, meet course prerequisites, and obtain consent of instructor. In addition, the student must obtain permission from his/her advisor and the School of Graduate Studies. Up to eight fellowship courses may be permitted in aggregate.

3. Thesis research (651 and 701) and similar courses cannot be taken as fellowship courses and prior rules for 701 (dissertation research) are not changed by this policy.

4. Fellowship courses can not be audited. The grade that a student receives in the course will not count toward the degree program GPA.

5. Fellowship courses can not be used toward a degree program at Case Western Reserve University.

6. Notwithstanding any of the foregoing provisions and policies, the rules, regulations, and terms of tuition and credit enrollments for each school shall remain in full force and effect.

7. Registration for fellowship courses within the College of Arts and Sciences is not permitted in the summer term.

Guidelines for Multidisciplinary Graduate and Graduate Professional Studies
Multidisciplinary studies have as their goal the education of individuals who can make contributions to academic disciplines or professional endeavors that would be less likely to be accomplished by individuals with a background in a single discipline. Departments or faculty members may design a joint degree program, which will generally result in two degrees, or a multidisciplinary degree, which will generally result in a single degree which has a broader perspective than similar existing degrees. Such programs should meet challenges of new interdisciplinary knowledge and/or developments requiring new combinations of talent. In addition, such programs or degrees should enhance and not duplicate existing programs in the university. Individual students with specific multidisciplinary interests that desire to pursue them at Case Western Reserve University and faculty members who wish to run pilots for joint degree programs or multidisciplinary degrees are encouraged to do so, even if no official joint or multidisciplinary degree program currently exists, by organizing an individual joint degree or an individual multidisciplinary degree. Such degrees require faculty and departmental support. Guidance for the design and approval of both such programs
and such individual degrees is available from the School of Graduate Studies.

Graduate Student Rights and Responsibilities
It is the responsibility of the student to become familiar with the general rules and regulations of the university, not just those of the School of Graduate Studies. A member of the University community who is accused of violating any of these rules and regulations is subject to university disciplinary action. Due process procedures of adequate notice of all charges and a fair hearing will apply. Case Western Reserve University has established a mechanism whereby students may express a grievance against the actions of other students or members of the faculty and staff. A statement of the policies and procedures to be followed in the case of academic infractions by graduate students may be obtained through the School of Graduate Studies. The policies and procedures governing all other infractions are detailed in the university’s Case Student Handbook (http://studentaffairs.case.edu/handbook). The University Office of Student Affairs (http://students.case.edu) should be consulted for non-academic infractions.

It is also the responsibility of the student to become acquainted with the general regulations and administrative procedures governing graduate study, together with the departmental or school regulations which apply to the student’s course of study, and, in consultation with the faculty advisor or advisory committee of the supervising unit, to plan the program and carry out the work in accordance with these regulations and procedures.

Departmental Responsibility for Requirements
Requirements for master’s and doctoral degrees beyond those set forth in these regulations may be established by departments or curricular program committees with the approval of the dean of graduate studies. Individual students may be required to take courses beyond the published requirements in order to successfully complete their degree programs. In such instances the student must be notified in writing upon matriculation by the chair of the department or curricular program, with a copy to be filed in the School of Graduate Studies.

Maintenance of Good Standing
A student maintains good standing in the School of Graduate Studies by registering each fall and spring semester unless on an official leave of absence which has been approved by the School of Graduate Studies. A student is in good standing who meets the standards set by the academic department and the School of Graduate Studies to ensure normal progress toward the fulfillment of the stated requirements at levels of quality without warning or probation or extension of the allowable time limit for degree completion. Students whose quality point averages fall below minimum standards (3.00 for doctoral students; 2.75 for master’s) will automatically be placed on probation until the minimum standards are achieved. In addition, a student will be subject to separation from the university for any of the following reasons:

1. Failure to achieve a quality-point average of 2.50 or higher at the completion of 12 semester hours or 2 semesters of graduate study.
2. Failure to achieve a quality-point average of 2.75 or higher at the completion of 21 semester hours or 4 semesters of graduate study.
3. Failure to receive a grade of S in thesis research 651 or dissertation research 701. A student who receives a grade of U in thesis (Course 651) or dissertation research (Course 701) will be placed on probation and be subject to separation. The probationary status will be recorded on the student’s transcript. The student must be removed from probation by the end of the semester immediately following receipt of the grade of U by repeating the course for the same number of credit hours, and achieving a grade of S. The tuition and associated fees for the repeated course may be the responsibility of the student. Although removal from probation restores the student’s good standing, the grade of U received will not be canceled or substituted by the grade of S subsequently received. Separation will occur if the student placed on probation receives another grade of U in the following semester; or, if the School of Graduate Studies, in consultation with the academic unit, determines that the student is unlikely to be successful in working independently and productively toward the completion of the thesis or dissertation research.
4. Failure of a conditionally or provisionally admitted student to satisfy the conditions or provisions stated in the letter of acceptance by the end of the first academic year (2 semesters) or after 18 credits of course work.
5. Failure to make progress towards degree completion. If the student is not making progress towards degree completion, and it has been judged that the student is unlikely to be successful in working independently and productively toward the completion of clinical requirements, thesis or dissertation research the department and/or the dean of graduate studies (in consultation with the department) can recommend academic separation.
6. In addition to disciplinary actions based on academic standards, on recommendation of the student’s department or school, the School of Graduate Studies can suspend or separate a student from the university for failure to maintain appropriate standards of conduct and integrity. Such a suspension or separation will be implemented only for serious breaches of conduct that threaten to compromise the standards of a department or create concern for the safety and welfare of others. In the event of such suspension or separation, the student will be entitled to an appeal through the grievance procedure of the Graduate School.

Maintenance of Quality-Point Average
In calculating the quality-point average, courses taken as a student in the School of Graduate Studies at the 400 level or above as well as any courses accepted toward fulfillment of degree requirements for which quality points are given will be counted, including courses which may need to be repeated. Unless otherwise stated by the department, a minimum cumulative quality-point average of 2.75 is required for the awarding of the master’s degree, and a minimum cumulative quality-point average of 3.00 is required for awarding of the doctoral degree. Any department, school, or curricular program committee may choose to establish quality standards higher than those stated above if such additional requirements are made known in writing to the students upon matriculation and are recorded with the School of Graduate Studies. In that case, the departmental standards supersede the minimum standards. Students who do not maintain the minimum quality point average will be placed on academic probation until the minimum standard has been achieved.

Course Repeat Policy
Graduate students may petition their department chair to repeat a maximum of two courses during their degree program in order to improve their performance. When a course is repeated, the first grade will remain visible on the transcript but will be removed from the calculation of the cumulative grade point average and the grade point average for the semester in which the course was first taken. The new grade will then be used for calculation of the cumulative grade point average and the grade point average for the semester in which it was earned, regardless of whether the new grade is higher or lower than the first
grade. The student’s transcript will show the comment “Repeated: No credit awarded” directly below the original grade. However, if the first attempt of the course resulted in a passing grade, but the second attempt results in a failing grade, then the original grade will remain. Similarly, if a student withdraws from a course that is being repeated, the Course Repeat Option will not be applied and the original grade will stand. Course repetition may be exercised according to the following conditions:

1. The course repeat option can only be used on course in which a C or lower was earned. Courses with a grading basis of P/NP are not eligible under this policy.
2. A student may not use the Pass/No Pass Option on a course that is being repeated.
3. A student may only use the repeat option on the same course.
4. Research based courses 651, 601 and 701 are exempt from this repeat policy. Thesis research course 651 and dissertation research course 701 grading policies can be found in this bulletin.
5. The course repeat option may not be exercised after a degree has been awarded.
6. Approval from student’s advisor and department chair are required. Some departments may also require the signature of their director of graduate studies and/or graduate affairs committee.
7. The tuition and associated fees for a repeated course may be the responsibility of the student.

Periodic Review and Evaluation of Doctoral Student Progress

In order to achieve excellence in student mentoring in doctoral programs within the School of Graduate Studies at Case Western Reserve University, an annual review of student progress toward the degree is required for every doctoral student. This review has two purposes: i) to support mentoring of students by providing regular and timely feedback that will enhance their success at CWRU and their career goals and professional development, and ii) to evaluate progress toward completion of the degree. To achieve these goals, the review should evaluate the previous year’s progress, detail the student’s strengths and areas that need improvement, and make recommendations for future action to complete the degree.

Each doctoral program shall develop its own annual review format and timing within these minimal guidelines:

1. Every doctoral student will submit an annual progress report to their program, department, or school. The report should describe progress toward the degree in the past year, future plans for completing the degree, career goals and progress toward professional development.
2. Faculty of the program, department, or school will review the student reports to evaluate student progress in the program. The review process shall include at least two faculty members, such as the faculty advisor, dissertation or thesis chair or committee, graduate student director, or other subset of faculty designated by the department. Additional faculty members may be asked to provide input to help the review process.
3. The findings of the evaluation shall be communicated to the student in a written report and, whenever possible, discussed in person, that details the student’s current status in the program, progress towards completion, career goals and professional development, and makes concrete suggestions for future actions.
4. Master’s level students may be evaluated in a similar fashion at the discretion of the program, department, or school.

If a doctoral program already has an annual review policy in place, the program shall inform the School of Graduate Studies of what form that review takes. For programs that do not have an annual review policy, the School of Graduate Studies requests that they create an annual review policy within a year from the approval of the policy. This policy does not mandate the use of one student review format. Examples of existing formats for review of student progress will be posted on the Graduate Studies website. For some programs, the annual report can be coordinated with other reporting needs (e.g., NIH grants) so as to eliminate redundancy in reporting for the student.

Compliance with this policy will be monitored by SGS. Programs shall provide an annual list of names of students who have been reviewed by June 30th. A template of the department review form shall be provided to SGS. Copies of an individual student’s annual reviews will be made available to SGS upon request.

The School of Graduate Studies shall conduct a process evaluation two years after implementation of this policy.

Residency Requirement

The doctoral residency requirement is intended to ensure a period of intensive academic interaction with faculty and peers and of sustained independent research. Graduate students are considered to be in residence when they are fully engaged in academic work. As resident students they may teach at the university, take graduate courses, assist in course development, and engage in research or in other scholarly activities at the university. Regardless of the nature of the work, the student’s regular presence at the university is expected during fulfillment of the residency requirement.

The formal fulfillment of residency requires continuous registration in at least six consecutive academic terms (fall, spring and/or summer) from matriculation to a period not exceeding five years after the first credited hour(s) of dissertation research (701). The period while students are on a leave of absence do not count towards fulfilling the residency requirement. Within the context of continuity of registration, departments may enact other restrictions. In such instances, the departmental requirements take precedence and must formally be disclosed to the student at matriculation. This is meant to be a reflection of the appropriate reality that departments and fields have different norms and traditions of graduate study.

Time Limitation

All the requirements for the master’s degree must be completed within five consecutive calendar years from the semester of the first credited 701 registration, including leaves of absence, to complete all requirements for the doctorate. Any graduate student who fails to complete the requirements within the five year limit for his or her degree program will be subject to separation from further study unless granted an extension by the School of Graduate Studies with the recommendation of the faculty advisor or advisory committee and approval by the department chair. An extension may be granted if the student and his or her advisor work out a plan of action for degree completion within a specified time frame which must be endorsed by the department chair. Students will be expected to meet all the specified deadlines outlined in the plan of action. The minimum acceptable registration during this extended period for each semester until graduation is three credit hours of 651 or 701. Plan B master’s students must register for at least three credits of appropriate course work.
**Graduate Student Holiday, Vacation, Parental Leave and Sick Leave Policies**

These policies apply to graduate students in the School of Graduate Studies who receive stipends that support their effort toward earning a degree during the period when they receive support. They represent the minimum to which graduate students are entitled.

If a graduate student receives a stipend, they will receive support for holidays, vacations, sick leave, and parental leave as set forth below. The stipend support for those days will be at the same rate as for normal work days. For all anticipated leaves longer than two weeks, appropriate departmental approvals must be obtained and paperwork submitted to the School of Graduate Studies prior to the start of the leave.

These policies do not supersede other university policies concerning attendance or residence at the university (e.g. participating in classroom activities as a student or teaching assistant). These policies only apply to student effort toward earning a degree.

**Holidays**

Graduate students are entitled to observe all university closings for holidays and other recognized events.

**Vacations**

Graduate students are allowed two weeks of vacation per calendar year (10 traditional work days) if they receive full support during a 12-month period. Students who receive less than 12 months of support are not entitled to vacation during the period of support. The dates of vacations must be approved in advance by the student’s research mentor to ensure that time-sensitive work is not disrupted.

Vacation days can be accrued from one year to the next year only with the prior written approval of the Program and only up to a maximum of 20 traditional work days, to allow for international travel, for example. There is no terminal leave.

The times between academic terms and the summer are considered part of the active training period and are not to be regarded as vacation time.

**Sick Leave**

Graduate students are entitled to two weeks (10 traditional work days) of sick leave per year, with no year-to-year accrual. Sick leave may be used for medical conditions related to pregnancy and childbirth. Under exceptional circumstances, additional sick leave days may be granted following receipt of a written request from a physician, and prior written approval by the Program.

**Parental Leave**

Graduate students are entitled to paid parental leave for the adoption or birth of a child. The primary caregiver is entitled to 6 weeks leave and the other parent or domestic partner is entitled to 3 weeks leave. When both parents are supported graduate students, the leave may be used consecutively or together. The leave must be used within 12 months of birth or adoption. Parental leave must be approved in advance in writing by the Program. It is permissible to add parental leave and sick leave together for the adoption or birth of a child.

**Unpaid Leave**

Students who require additional leave beyond what is stipulated above must seek prior written approval from the School of Graduate Studies for an unpaid leave of absence. Approval for a leave of absence must be requested in advance by the student and the student should provide documentation for the leave request and obtain approval. Conditions for the leave and approval must be submitted to the School of Graduate Studies. Continued coverage of health insurance is allowable as permitted within the guidelines of University Health Services and with written approval by the Program and School of Graduate Studies.

**Unused Leave**

A student is not entitled to receive any form of compensation for any unused holidays, vacation days, sick leave, parental leave, and/or other accrued time off.

**Disclaimers**

These policies do not supersede any HR policy. In addition, these policies do not create a contractual relationship with any student and the policies may be amended at any time by the Faculty and the School of Graduate Studies.

The School of Graduate Studies policies regarding continuous registration and leave of absence still apply. Maintenance of leave records is the responsibility of the academic department.

**Leave of Absence from Graduate Study**

Students undertaking graduate work are expected to pursue their studies according to a systematic plan each year whether registered for full or part-time study. Occasionally a student finds it necessary to interrupt his or her studies before completion of the graduate program. A leave of absence is not to be requested unless the circumstances are such that the student cannot continue graduate study. Under such circumstances the student must request in writing a leave of absence for a period not to exceed two consecutive regular academic semesters. Forms (http://gradstudies.case.edu/current/forms.html) can be found at the School of Graduate Studies website. In exceptional circumstances, the leave can be extended for another two semesters. However, the maximum amount of leave permitted per graduate program is four semesters. The reason for the leave must be stated clearly, and the request must be submitted to the School of Graduate Studies with the written endorsement of the student’s academic department. During a leave of absence the student must not seek aid from faculty members or use of the facilities of the university. This means that students may not take exams or defend theses and dissertations while on a leave. A leave of absence does not extend the maximum time permitted for the completion of degree requirements, and a leave cannot be taken while students are on extension of the five-year limit. At the expiration of the leave the student must resume registration unless formally granted an extension of the leave. Retroactive leaves are not permitted. A student who fails to obtain a leave of absence, or who fails to register following an official leave, must petition the School of Graduate Studies for reinstatement in order to resume work as a student in good standing at the university.

A student who is granted a maternity or paternity leave of absence related to infant care, as well as those who must fulfill military duty obligations, can petition to extend the five-year time limit associated with completion of the degree. The length of the extension may not exceed two years. International students must check with the Office of International Student Services before petitioning for a leave of absence, as such a leave can affect their visa status.

**Withdrawal, Resignation, and Reinstatement**

Students must maintain continuous registration in the fall and spring semesters throughout their degree programs unless granted an official leave of absence. Students who fail to register for any academic term will be automatically withdrawn from their programs. Students who are withdrawn from their programs must petition for reinstatement in
order to continue graduate study. The petition must be approved by both the student’s department and the School of Graduate Studies before the student may register for further course work as a student in full standing. In each case of readmission with full standing, the official letter will state the terms of readmission, including future time limits for the degree program, and the past course work that will be credited toward the degree. If more than 24 months have elapsed since the last registration, students may have to resubmit file materials if requested by the School of Graduate Studies.

Transfer of Credit

Transfer of credit from another university toward master’s and doctoral degree requirements is awarded for appropriate course work (not applied to another degree program) taken prior to admission. Transfer of credit must be requested in the student’s first academic year and must be appropriate for the student’s planned program of study. For master’s candidates, transferred credit is limited to six semester hours of graduate-level courses, and no credit for master’s thesis may be transferred from another university. No transfer of credit will be awarded towards the PhD degree except by petition, and no credit for the doctoral dissertation may be transferred from another university.

Students who wish to receive credit for courses taken outside the university once they are enrolled must petition for approval before taking the classes. All transfer of credit requires approval from the student’s advisor, the departmental chair or graduate committee, the department for which credit is being granted, and the School of Graduate Studies. Such courses must have been taken within five years of first matriculation at Case Western Reserve University and passed with grades of B or better. Forms can be found at the School of Graduate Studies (http://case.edu/gradstudies/current-students/forms).

Transfer of credit does not include the transfer of grades and therefore can not be used to fulfill GPA or percentage of graded coursework policies.

Internal Transfer of Credit

Students of exceptional ability in the undergraduate programs of Case Western Reserve University who have the approval of the Office of Undergraduate Studies and the School of Graduate Studies may apply to receive credit for graduate courses completed in excess of the undergraduate degree requirements.

Graduate students who internally transfer to another degree program may seek approval to transfer coursework from the original degree program by petition (http://gradstudies.case.edu/current/forms.html).

Changes in Registration

To add or withdraw from courses or to change registration from credit to audit, a student must obtain the appropriate official form to submit to the University Registrar in accordance with the dates published each academic term for such actions to be taken. Students must make appropriate changes to their schedules by the end of the second week of classes in order to avoid paying full tuition for a withdrawn course. Only complete withdrawal for the semester entitles a student to a percentage refund of the withdrawn courses after the second week of classes. Failure to attend class or merely giving notice to the instructor will not be regarded as official notice of withdrawal or change. When making changes in registration, an international student must be aware of maintaining full-time status. Full-time status requires registration for a minimum of 9 semester hours per semester (or 1 semester hour of 651 or 701). Students financed by federal loans must remain registered for at least 6 semester hours (defined as half-time) each semester to maintain continued eligibility for that funding or to initiate such a loan.

Graduation

A candidate for a degree awarded by the School of Graduate Studies must make application for the degree to the School of Graduate Studies by the deadline established for that semester. Students are encouraged to visit the School of Graduate Studies website at the beginning of the semester in which they intend to graduate to obtain a packet of graduation materials for either the Master’s (http://case.edu/gradstudies/current-students/graduation) or Doctorate (http://case.edu/gradstudies/current-students/graduation) degree. The candidate must meet all the deadlines for completion of degree requirements set forth in the calendar. All candidates must be registered for credit and in good standing during the semester in which the degree is awarded. The diploma and official transcript reflecting the conferral of degree will not be released to the candidate until all outstanding tuition, fees, and fines are resolved.

Waiver of Registration

It is a requirement of the School of Graduate Studies that a student be registered for credit in the semester in which he or she completes all the requirements to graduate in accordance with established deadlines for that semester. For a student engaged in thesis or dissertation research the completion of all requirements to graduate is not easily predicted, making it difficult to adhere to scheduled deadlines. If a student will not be able to meet the degree requirements to graduate in one semester, but will finish before the next semester begins, he or she can apply for a waiver of the requirement to be registered in the semester of graduation. To be granted a waiver of registration students must be registered for the appropriate thesis or dissertation credit hours in the semester (or summer session) immediately preceding the semester of graduation, complete all degree requirements including a current application to graduate, and submit all required materials to the School of Graduate Studies by the end of the Drop/Add period of the next semester.

A student who qualifies for the waiver will be awarded the degree at the next graduation without the need to be registered. If a student fails to meet the waiver deadline, he or she will be required to register for the appropriate thesis or dissertation credit hours in the next semester, and to reapply for graduation in that semester.

Exceptions to Regulations

Students have the right to petition for exceptions to these regulations. Such a petition should be addressed to the School of Graduate Studies. In most cases the student’s department or program committee must endorse the petition.

Graduate Student Grievance Procedure

It is the responsibility of the School of Graduate Studies to ensure that all students enrolled for graduate credit at Case Western Reserve University have adequate access to faculty and administrative consideration of their grievances concerning academic issues. A three-step procedure has been established for graduate students to present complaints about academic actions they feel are unfair.

1. Students with complaints should first discuss their grievances with the person against whom the complaint is directed.
2. In those instances in which this discussion does not resolve a grievance to the student’s satisfaction, a complaint should be presented in writing to the department chairperson. If the complaint is against the department chair and is not resolved with this
individual, the complaint should be presented to the dean of the school/college.

3. In the event that a decision still appears unfair to the student, the student may bring the matter to the attention of the dean of graduate studies. The dean may ask the student to put the complaint in writing. The dean will then discuss the case with the student and the department chair to evaluate the particulars and to make a ruling on it. As the situation warrants, the dean may appoint a Grievance Committee to recommend what action should be taken. In this event the Committee will be composed of two faculty members selected from the Committee on Graduate Studies of the Faculty Senate and two graduate students selected either from the Executive Committee of the Graduate Student Council or from the student members of the Committee on Graduate Studies.

The dean of graduate studies has the responsibility for the final decision, and the ruling from the School of Graduate Studies will be considered final and binding on the persons involved in the grievance. Additional information about the grievance procedure can be obtained from the School of Graduate Studies.

It should be understood that this grievance procedure relates solely to graduate student complaints concerning academic issues. The procedure for handling complaints about other matters is detailed in the Graduate Student Handbook.

**Procedures and Sanctions for Graduate Student Academic Infractions**

Graduate students accused of violating the university’s standards of conduct, which are detailed in this Academic Integrity Policy (http://case.edu/gradstudies/about-the-school/policies-procedures), are entitled to adequate notice of all charges and to a fair hearing and may subsequently be subject to disciplinary action. The process that is outlined in the Academic Integrity Policy will apply to academic infractions, e.g., cheating on examinations, plagiarism, and other forms of dishonesty in academic activities. Additional information is available from the School of Graduate Studies.

**School of Graduate Studies Academic Requirements**

**Academic Requirements for Master's Degrees**

In recognition that the objectives of master’s degrees differ for various departments and for individual students, especially in the importance given to research, two general plans for master’s degrees may be followed. Master’s Thesis option (Plan A) is for MA or MS degrees with a thesis based on individual research and a final oral examination. Master’s Non-Thesis option (Plan B) is for MA, ME, MFA, MPH, MSA, or MS degrees without a thesis but requiring a comprehensive examination and/or a major project to be administered by the academic unit.

Within the framework of these general regulations, it is expected that a relevant program of study will be planned for each candidate for the master’s degree by the student and the faculty advisor or advisory committee. This planned program of study (PPOS) must be submitted to the School of Graduate Studies by the end of the second semester. Such a program should include appropriate courses, thesis, and/or project hours, and may also include, where relevant, such experiences as field work or practicum. Guides to submitting and updating the PPOS through the student information system are available from the University Registrar.

**Master’s Thesis Option (Plan A)**

The minimum requirements for the master’s degree under the thesis option are 18 semester hours of course work at the 400-level or higher plus a thesis equivalent to at least 9 semester hours of registration, or 21 semester hours of course work, with at least 18 hours of coursework at the 400-level or higher plus a thesis equivalent to at least 6 semester hours of registration. Courses taken at the 300 level should only be allowed when no 400 level course is available or under unusual circumstances, both of which must be approved via a petition to Graduate Studies. At least 12 semester hours of course work must be graded. Once registered for thesis credit (Course 651), a student must continue 651 registration each succeeding regular semester until graduation. However, if a student is registered for course work or research toward the doctorate in the semester in which the thesis examination is expected to occur, concurrent registration for 651 is not required.

Each student must prepare an individual thesis. Joint theses are not permitted. The written thesis must conform to regulations concerning format, quality, and time of submission as established by the dean of graduate studies. Detailed instructions (http://case.edu/gradstudies/current-students/electronic-theses) can be obtained from the School of Graduate Studies website.

For completion of master’s degrees under the thesis option, an oral examination (defense) of the master’s thesis is required. This examination is conducted by a committee of at least three members of the university faculty. The candidate’s thesis advisor customarily serves as the chair of the examining committee. The other members of the committee are appointed by the chair of the department or curricular program faculty supervising the candidate’s course of study. The examining committee must agree unanimously that the candidate has passed the thesis examination. Because theses are made public immediately upon acceptance, they should not contain proprietary or classified material. When the research relates to proprietary material, the student and advisor are responsible for making preliminary disclosures to the sponsor sufficiently in advance to permit timely release of the thesis, and these plans should be disclosed when the thesis is submitted to the School of Graduate Studies.

**Master’s Non-Thesis Option (Plan B)**

The minimum requirements for the master’s degree under the non-thesis option are 27 semester hours of course work with at least 12 semester hours of graded course work, a comprehensive examination, and in some fields, an approved project. At least 18 semester hours of course work must be at the 400 level or higher. Courses taken at the 300 level should only be allowed when no 400 level course is available or under unusual circumstances, both of which must be approved via a petition to Graduate Studies.

Each candidate for the master’s degree under the non-thesis option must pass satisfactorily a comprehensive examination to be administered by the department or curricular program committee. The examination may be written or oral or both. A student must be registered during the semester in which any part of the comprehensive examination is taken. If not registered for other courses, the student will be required to register for one semester hour of EXAM 600 Master’s Comprehensive Exam before taking the examination.
Academic Requirements for Doctoral Degrees

The degree of Doctor of Philosophy is awarded in recognition of in-depth knowledge in a major field and comprehensive understanding of related subjects together with a demonstration of ability to perform independent investigation and to communicate the results of such investigation in an acceptable dissertation.

Curricular Requirements

Within the framework of these general regulations, it is expected that a relevant program of study will be planned for each candidate for the doctorate by the student and the faculty advisor or advisory committee. This planned program of study (PPOS) must be submitted to the School of Graduate Studies before the end of the second semester. Guides to submitting and updating the PPOS through the student information system are available from the University Registrar's website. (https://case.edu/registrar/faculty/sisguides)

Although specific requirements vary among departments, students entering with a bachelor's degree will satisfactorily complete a minimum of 36 semester hours of courses (which may include independent study/research, course 601), tutorials, and seminars. All course work must be at the 400 level or higher, and at least 24 semester hours of course work must be graded. For students entering with an approved master's degree, completion of at least 18 semester hours of 400-level or higher course work and at least 12 semester hours of this course work must be graded. A minimum of 18 semester hours of dissertation research (Course 701) is required for all doctoral students.

Examination Requirements

In order to meet the requirements for the doctorate, a student must pass satisfactorily a general examination (or a series of examinations covering different fields) specified and administered by the student's department or supervising committee. The examination generally precedes advancement to candidacy. A student must be registered during the semester in which any part of the general or qualifying examination is taken. If not registered for other courses, the student will be required to register for one semester hour of EXAM 700 PhD General/Qualifier Exam, before taking the examination. A student who fails the examination on the first attempt may be permitted to take the examination a second time within one year at the discretion of the department. Except in unusual circumstances, a student who fails the examination a second time will be separated from further graduate study within the same department or program.

Advancement to Candidacy

The formal acceptance of a student as a candidate for the doctoral degree is the responsibility of the student's department or the committee supervising the doctoral program in accordance with the written procedures of the academic unit. Generally, advancement to candidacy allows the student to enter the dissertation research phase of the degree program, and occurs after all course work and exam requirements are satisfied. At its discretion the supervising unit may require a student to pass qualifying examinations before candidacy is granted. Students are expected to make regular and continuous progress toward the degree. Advancement to candidacy in a PhD program should occur within a maximum of 6 years post-matriculation with a bachelor's degree (no later than at the completion of 36 semester hours of graduate study) and 4 years post-matriculation with a master's degree (no later than at the completion of 18 semester hours of graduate study). Students may continue in pre-candidacy status beyond this time by means of a petition to the School of Graduate Studies by the student and program director, based on evidence of student progress toward the degree. Individual programs can require advancement to candidacy before the time limit set in this policy.

The School of Graduate Studies must promptly be notified in writing of the decision concerning a student's advancement to candidacy, and a copy of the notification must be sent to the student concerned. A student who is refused candidacy status may not undertake further study for credit toward the doctoral degree within the same department or supervising unit. With the approval of both the department concerned and the School of Graduate studies, such a student may:

1. Take additional courses, if required, in order to complete an approved master's degree in that department.
2. Seek admission to the graduate program of another department.

Course 701 Requirements (Dissertation Research, Pre- and Post-Candidacy)

When a student has been advanced to candidacy, he or she may begin dissertation research by formally registering for course 701 credits. At the point at which students begin registering for course 701, the department must identify a university faculty member who will serve as the doctoral student's principal research advisor and formally notify the School of Graduate Studies. Students who have been advanced to candidacy may register for 1-9 credits of course 701 each fall and spring semester (or up to 6 credits for the summer when needed). In certain cases, students who have not advanced to candidacy may begin registering for up to a total of 6 credit hours of course 701 at the discretion of the department and upon written notification to the School of Graduate Studies. Pre-Candidacy 701 hour(s) may be taken concurrently with course work. Once a student begins registration of 701 hours, he or she must register for at least one credit hour of 701 each semester until graduation. Doctoral students have five consecutive calendar years from the semester of the first credited 701 registration, including leaves of absence, to complete all requirements for the doctorate.

Foreign Language Requirements

Although there is no general foreign language requirement for the doctorate, each department or supervising committee may set such requirements as are appropriate to the student's program of study. It is the student's responsibility to ascertain the foreign language requirements approved by the supervising unit. Each department must notify the School of Graduate Studies in writing of the specific language(s) required and the date of examination determining the student's proficiency in the required language(s).

Dissertation Requirements

All candidates for the PhD degree must electronically submit a dissertation as evidence of their ability to conduct independent research at an advanced level. The dissertation must represent a significant contribution to existing knowledge in the student's field, and at least a portion of the content must be suitable for publication in a reputable professional journal or as a book or monograph. Students must prepare
Dissertation Research Advisor

Each doctoral student is responsible for becoming sufficiently familiar with the research interests of the department or program faculty to choose in a timely manner a faculty member who will serve as the student’s research advisor. The research advisor is expected to provide mentorship in research conception, methods, performance, and ethics, as well as focus on development of the student’s professional communication skills, building professional contacts in the field, and fostering the professional behavior standard of the field and research in general. The research advisor also assists with the selection of the other faculty to serve as members of the dissertation advisory and defense committee.

Dissertation Advisory and Defense Committee

The composition of each student’s dissertation committee must have formal approval by the School of Graduate Studies on recommendation of the chair of the department, division, or curricular program committee. The dissertation committee must consist of a minimum of four members of the University faculty (any tenured or tenure-track Case Western Reserve University faculty member, and any CWRU full-time faculty member whose primary duties include research who is authorized to serve as a PhD dissertation committee by the school or college through which they are affiliated with the university). At least one of these CWRU faculty must hold a primary appointment that is outside of the student’s department, program, or school. The chair of the committee must be a CWRU tenured or tenure-track faculty member in the student’s program. The student’s dissertation research advisor must be a member of the committee and may serve as chair if consistent with departmental policy.

Persons who are not members of the University faculty may serve as additional members of the defense committee, subject to approval by the School of Graduate Studies. A petition with the rationale for the request must be submitted to the School of Graduate Studies along with the proposed member’s curriculum vitae. Under special conditions, a former faculty member whose time of leaving the university has not exceeded 18 months may be approved as a committee member by the School of Graduate Studies.

Throughout the development and completion of the dissertation, members of the dissertation advisory committee are expected to provide constructive criticism and helpful ideas generated by the research problem from the viewpoint of their particular expertise. Each member will make an assessment of the originality of the dissertation, its value, the contribution it makes, and the clarity with which concepts are communicated, especially to a person outside the field. The doctoral student is expected to arrange meetings and maintain periodic contact with each committee member. A meeting of the full committee for the purpose of assessing the student’s progress should occur at least once a year until the completion of the dissertation.

Final Oral Examination (Defense of Dissertation)

Each doctoral candidate is required to pass a final oral examination in defense of the dissertation. The examination may also include an inquiry into the candidate’s competence in the major and related fields.

The defense must be scheduled with the School of Graduate Studies no later than three weeks before the date of the examination. The chair of the examining committee should give approval to schedule the defense when the written dissertation is ready for public scrutiny. The candidate must provide to each member of the committee a copy of the completed dissertation at least ten days before the examination so that the committee members have an opportunity to read and discuss it in advance.

The dissertation defense committee is responsible for certifying that the quality and suitability of the material presented in the dissertation meet acceptable scholarly standards. A student will be certified as passing the final oral examination if no more than one of the voting members of the committee dissents.

Institutional Review Board (IRB)

The promotion of scholarship and the discovery of new knowledge through research are among the major functions of Case Western Reserve University. If this research is to be meaningful and beneficial to humanity, involvement of human subjects as experimental participants is necessary. It is imperative that investigators in all disciplines strive to protect human subjects. University policy and federal regulations demand compliance. Per federal regulations (45 CFR 46), all research involving human subjects requires submission of an IRB application prior to initiation of research to the Case Western Reserve IRB.

Each IRB application must have a faculty member noted as the Responsible Investigator. Applications that are not fully completed as instructed will not be accepted. See university policy on the
involvement of human participants in research for guidelines under which investigations involving human subjects may be pursued.

### Course Designations

Courses numbered 100 to 399 are undergraduate-level courses. Courses numbered 400 and higher are graduate-level courses.

Graduate Students are expected to take courses at the 400-level or above. Some departments do allow courses at the 300-level to be used for master’s programs, however this should only occur when no graduate-level course is available or under unusual circumstances, both of which require a petition to Graduate Studies. Departments are strongly encouraged to create cross listed graduate-level courses to accommodate this need. Graduate-level versions of courses must require additional work beyond that which is assigned to the undergraduate students in the course.

### Grading System

See the University Registrar (http://bulletin.case.edu/universityregistrar/#grading_systemtext) section of this Bulletin for a list of valid grades for the School of Graduate Studies and their appropriate use in assigning to graduate students. The only grades that can be changed after they have been assigned by the instructor are Incompletes (I). All others will remain permanently on the student's academic record. Additional work cannot be done to change an existing grade to a higher grade.

There are some grading schemes in the School of Graduate Studies that have important policy implications. They are:

**Incomplete (I)**

Grades of I should only be assigned for letter-graded and Pass/No Pass courses for extenuating circumstances and only when a student fails to complete a small segment of the course. Students may not sit in the same course in a later semester to complete the work required for the original course. All work for the incomplete grade must be made up and the change of grade recorded in the Student Information System (SIS) (https://sis.case.edu/psp/P90SCWRF/EMPLOYEE/HRMS/c/cW_SR_MENU.CW_CONFID_AGREEMNT.GBL) by the date specified by the instructor, but no later than the last day of class in the semester following the one in which the I grade was received. Grade changes received after that date must be accompanied by a petition signed by both the advisor and the chair of the department indicating the reason for the late change and must be approved by the Deputy Provost. If the student cannot complete the work by the end of the following semester, he or she must petition for an extension which must be endorsed by the instructor, explain the reasons why the work has not been completed, and include a new date for completion. Students will be allowed only one extension of no more than one additional semester to complete the work for an I grade. Unresolved Incomplete grades will remain permanently on the student’s academic record, if the work is not made up by the designated deadline. A student who has a permanent Incomplete for a required course must retake the course in a later term.

**Pass/No Pass (P/NP)**

Some graduate courses are graded on a pass or no pass basis, and students need to be aware of the regulations governing letter graded and pass/no pass credits. Of the minimum credit hours required beyond the bachelor's degree to complete course work requirements, at least 12 credits must be letter graded for the master's degree, and at least 24 credits must be letter graded for the PhD degree. For students with approved master's degrees who are admitted to PhD programs, at least 12 credits of the required minimum of 18 credits of course work must be letter graded. Letter graded courses should be the courses most central to the student’s plan of study. Additional credit hours of letter graded course work may be specified by departmental policy. Performance evaluation for course 601 (Independent study/Research) is limited to P/NP grading.

**Satisfactory/Unsatisfactory (S/U)**

Grades of Satisfactory (S) and Unsatisfactory (U) are to be used exclusively for two courses: 651 thesis research and 701 dissertation research. Satisfactory indicates an acceptable level of progress towards completion of the research required for the degree, and Unsatisfactory indicates an unacceptable level of progress towards completion of the research for the degree. Any student who receives a grade of U will automatically be put on academic probation, and if a second U is received, the student will be separated from further study in his or her degree program. Students who receive a U must repeat the course for the same number of credits the following semester.

### Admission and Financial Aid

#### Financial Aid

Tuition payments and fees (http://case.edu/studentaccounts) are administered through the Bursar’s office. For more information about financial assistance, students should contact the Office of University Financial Aid (http://financialaid.case.edu).

#### Admission

Applicants with good academic records from fully accredited universities and colleges will be considered for admission to graduate study (http://case.edu/gradstudies) at Case Western Reserve University. Admission must be recommended by the department or professional school of the university in which the applicant proposes to study and must be approved by the dean of graduate studies. Prospective students apply for admission (http://case.edu/gradstudies/prospective-students/degree-programs-offered) through the School of Graduate Studies.

#### Admission of International Students

The admissions criteria for international students are the same as U.S. residents except for the following:

1. International students whose first language is not English must be able to speak, read, write, and comprehend English. English proficiency must be demonstrated by taking the Test of English as a Foreign Language (http://www.ets.org/toefl) (TOEFL). The minimum score to be considered for admission, depending on the format of the examination, is 577 (paper-based) or 90 (internet-based). IELTS test scores (http://www.ielts.org) are also accepted with a minimum score requirement of 7.0.

Applicants are exempt from the TOEFL requirements if they:

- speak English as their native language
- have completed a bachelor’s degree or higher at a foreign university where the instruction was in English
- have a earned a bachelor's degree or higher at a U.S. college or university
Please note that we are not able to offer "conditional admission" to students who do not meet the English language requirement.

1. To obtain a student visa, international students must demonstrate financial sufficiency by submitting bank statements and other financial documents indicating sufficient funds to support the tuition and living expenses for one academic year.

2. For those students who are to receive financial aid from the department, the amount of funds required will depend on the amount of the aid award. In some cases it will be living expenses, and in others more funds will be required.

When a letter of acceptance for an international student has been issued, a copy is sent to the Office of International Student Services (http://case.edu/international/international-student-services) where the I-20 is processed and sent to the student who must then obtain a student visa in order to begin study in the U.S.

**Non-Degree Students**

Individuals with earned bachelor’s degrees who want to enroll in classes for personal enrichment or to satisfy prerequisite course requirements for later admission to graduate programs must enroll as non-degree students through the School of Graduate Studies. Prospective non-degree students should apply for admission (http://case.edu/gradstudies/prospective-students/non-degree-students) through the School of Graduate Studies and submit an official transcript to verify their bachelor’s degree. Students may enroll in undergraduate and graduate level courses. Continuation in non-degree status is at the discretion of the School of Graduate Studies. Non-degree students are not permitted to enroll in more than 21 hours of coursework in one program. In order to continue taking courses in that program, the student must apply and be accepted into the graduate degree program. More information about enrolling as a non-degree student can be found at the School of Graduate Studies website (http://www.case.edu/gradstudies/prospective-students/non-degree-students). (http://gradstudies.case.edu/prospect/nondegree.html)

**Transferring Non-degree Course Work**

Applicants who are interested in transferring course work into graduate degree programs are encouraged to seek early advice from the departments to which they intend to apply to insure that courses taken as non-degree students will satisfy departmental requirements. Non-degree students cannot assume that they will be admitted to any graduate degree program, or that all course work taken will transfer into the program. Only 400 level and higher course work will be considered for graduate transfer. The term of the earliest approved, transferred course will establish the date of entrance into the degree program. Courses transferred from non-degree status must have been taken within five years of the first term of matriculation as a degree seeking student and passed with a grade of B or better. Students considering transfer into a degree program will need to meet a minimum matriculation requirement of two semesters and six semester hours of course work.

**Postgraduate Audit Program**

A postgraduate audit program allowing registration for coursework is available to individuals who hold a doctoral degree such as MD, DNP, DDS, or PhD and are involved in research or clinical programs at Case Western Reserve University. Additional information is available on the Office of Postdoctoral Affairs website (http://case.edu/postdoc).

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**Office of Postdoctoral Affairs**

Tomlinson Hall, Room 215
postdoc.case.edu
Phone: 216.368.0947; Fax: 216.368.4250

The Office of Postdoctoral Affairs, located within the School of Graduate Studies, is responsible for the appointment of postdoctoral scholars and fellows, as well as the development, implementation and monitoring of all university policies applicable to these positions. Additional information is available on the Postdoctoral Affairs website (http://postdoc.case.edu).

**Services**

The following are some of the services that are offered by the Office of Postdoctoral Affairs:

- Employment-related activities including letters of appointment
- Extension, and termination of appointments for postdoctoral scholars and fellows
- Orientation
- Administration of the Postdoctoral Benefits Program
- Coordination of all grievance procedures

**Definition of Postdoctoral Scholar**

A postdoctoral scholar is defined as a special class of employee who:

- holds a PhD or equivalent
- works on scholarly projects funded by grants obtained by others at the University or is funded by department funds
- is engaged in a mentored training relationship with a member of the University faculty, and
- actively pursues fellowship/grant funding for his/her own research project in order to develop his/her future professional career.

Postdoctoral scholars are not to be confused with postdoctoral fellows who are not employees of the University and receive their funding from training grants, fellowships, or grants they have applied for and obtained from outside sources and not faculty-sponsored research grants.

**Definition of Postdoctoral Fellow**

A postdoctoral fellow is defined as a trainee (not an employee) who:

- holds a PhD or equivalent
- works on scholarly projects funded by training grants, fellowships, or grants they have applied for and obtained from outside sources
- is engaged in a mentored training relationship with a member of the University faculty, and
- actively pursues fellowship/grant funding for his/her own research project in order to develop his/her future professional career.

**Criteria for Postdoctoral Scholars and Fellows**

- The postdoctoral scholar/fellow was recently (normally within 5 years) awarded a PhD or equivalent degree in an appropriate field.
- The appointment is temporary and postdoctoral scholars/fellows are expected to complete their mentored training within 5 years.
• The time devoted to this appointment as well as the specific scholarly training activities will be decided in collaboration with the mentor and committed in writing in the form of a training plan. All postdoctoral scholars/fellows will be encouraged to pursue additional training and other opportunities in the respective areas up to 25% of their time.

• The appointee will train under the supervision of a senior scholar (faculty mentor).

**Salary/Stipend Guidelines**
CWRU uses the current year NIH NRSA scale (http://case.edu/postdoc/administrators-mentors/postdoc-salary-stipend) as the minimum salary/stipend guidelines for all Postdoctoral Scholar and Postdoctoral Fellow positions. These guidelines apply regardless of funding source.

**Postdoctoral Benefits Program**
Postdoctoral scholars/fellow are eligible to participate in the Postdoctoral Benefits Program (http://case.edu/postdoc/current-postdoctorates/benefits-program), but are excluded from participating in all other CWRU benefits including employee retirement and benefit plans. The postdoctoral benefits program offers medical, dental, vision and life insurance plans.

**SIS Postdoctoral Appointment System**
The Student Information System (SIS) postdoctoral appointment component allows for all appointment information and documentation (including visa, CV, diploma, and other documents) to be submitted electronically through SIS. It will also allow for electronic approval flow. Additional information on the appointment process and documents required can be found on the Office of Postdoctoral Affairs (http://case.edu/postdoc/administrators-mentors/appointments-renewals-terminations) website.

**Postgraduate Audit Program**
A postgraduate audit program allowing registration for coursework is available to individuals who hold a doctoral degree such as MD, DNP, DDS, or PhD and are in training positions (e.g., fellows, etc.) in research or clinical programs at Case Western Reserve University. Additional information is available on the Office of Postdoctoral Affairs (http://case.edu/postdoc) website.
OFFICE OF UNDERGRADUATE STUDIES

357 Sears Building
http://www.case.edu/ugstudies
Phone: 216.368.2928; Fax: 216.368.4718
Jeffrey Wolcowitz, Dean of Undergraduate Studies
jeffrey.wolcowitz@case.edu

Office of Undergraduate Studies

Case Western Reserve University confers baccalaureate degrees based on programs offered by the faculties of the Case School of Engineering, the College of Arts and Sciences, the Frances Payne Bolton School of Nursing, and the Weatherhead School of Management. Some major programs are offered in collaboration with the School of Medicine, the Cleveland Institute of Art, and the Cleveland Institute of Music.

The faculties and administration are dedicated to offering educational programs that enable undergraduates to achieve disciplinary literacy in one or more major fields; to acquire educational breadth through study across the natural sciences, humanities and arts, and social sciences; and to learn to think critically and to communicate effectively. Overlap among the general education curricula for the various bachelor's degree programs allows students flexibility in the choice of majors and degree program. Furthering the University mission, the educational programs aim to foster the development of qualities of integrity, creativity, leadership, and societal engagement.

Advisors for first-year students, major field advisors, other faculty, and Undergraduate Studies deans assist students in selecting a field of study suited to each student's interests and qualifications. Students with broad educational interests and goals may choose to add one or more minor fields of study to their major field of study; may pursue concurrently two or more majors for the Bachelor of Arts degree, two or more majors for the Bachelor of Science in Engineering degree, or two or more majors toward the Bachelor of Science in Management degree; may complete one degree program with a secondary major from another degree program; or may earn two bachelor's degrees by completing both a Bachelor of Arts degree and a Bachelor of Science degree or by fulfilling the requirements for two Bachelor of Science degrees. The Bachelor of Music degree offered by the Cleveland Institute of Music may be combined with either a Bachelor of Arts or a Bachelor of Science degree at Case Western Reserve University. Qualified students who wish to accelerate their undergraduate and graduate or professional studies may earn the opportunity to begin in the senior year advanced study toward a graduate or professional degree.

The University provides undergraduates with a rich variety of experiential learning opportunities both on and off campus. Programs that engage students in curriculum-related employment include the Cooperative Education Program (http://engineering.case.edu/coop) and the Practicum Program (http://students.case.edu/careers/students/jobs/practicums). Study abroad (http://www.case.edu/studyabroad), the exchange program with Fisk University (p. 1083), and the Washington Semester (http://politicalscience.case.edu/undergraduate-programs/washington-center-program) immerse students in educational environments that build global and national knowledge and perspective. Research opportunities (http://www.case.edu/provost/source) for undergraduates abound at the university, in University Circle institutions, and in Cleveland. Individual departments offer independent study opportunities to motivated and qualified students, and some departments offer courses that incorporate practical field experience or community service. The location of the University in University Circle, with its outstanding array of cultural, educational, and health care institutions, and the proximity and accessibility of the University's professional schools and their facilities enable undergraduates to draw upon diverse and distinctive resources to enrich their education.

Mission Statement of the Office of Undergraduate Studies

The Office of Undergraduate Studies seeks to empower undergraduate students to make the most of their academic experience at Case Western Reserve University.

In pursuit of this goal,

- We collaborate with the schools, academic departments, faculty, and other administrative offices to develop programs and policies that support, inspire, and challenge students; and
- We guide and support undergraduate students as they navigate the university; discover, define, and realize their academic and career goals; acquire skills and experiences that foster meaningful lives of engagement in local, national, and international communities; and access advice and support services that will promote their success.

Administration

Jeffrey Wolcowitz, PhD
(Harvard University)
Dean of Undergraduate Studies

Nancy A. Dilulio, PhD
(Pennsylvania State University)
Senior Associate Dean of Undergraduate Studies

Support for First-Year Students

Michael R. Mason, MEd
(Kent State University)
Associate Dean of Undergraduate Studies for First-Year Students

Aaron S. Baker, MS
(University of Central Missouri)
Director of Cedar Residential College

Meredith Horrigan, MS
(Miami University)
Director of Magnolia Residential College

Samantha R. Miller, MEd
(Kent State University)
Director of Mistletoe Residential College

Antonio Tate, MA
(Kent State University)
Director of Juniper Residential College

Support for Upperclass Students

Denise Butler, MA, MLIS
(Kent State University)
Associate Dean of Undergraduate Studies
(students whose last names begin with Su-Z)
Support for Transfer, Exchange, and Non-Degree Students
Claudia C. Anderson, BA
(Youngstown State University)
Assistant Dean of Undergraduate Studies

Advising about National Scholarships and Fellowships
Amanda A. McCarthy, MEd
(Kent State University)
Assistant Dean of Undergraduate Studies

Advising about Health Careers
Steven P. Schenker, PhD
(Kent State University)
Assistant Dean of Undergraduate Studies

Wesley Schaub, MA
(Eastern Michigan University)
Pre-Medical Advisor

Advising about Law School
Terri A. Mester, PhD
(Case Western Reserve University)
Pre-Law Advisor

Undergraduate Majors and Minors

<table>
<thead>
<tr>
<th>Department</th>
<th>Subject</th>
<th>Degree</th>
<th>Available as</th>
<th>Gen Ed Requirements</th>
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<tbody>
<tr>
<td>ACC</td>
<td>Accounting</td>
<td>BS</td>
<td>Major or Minor</td>
<td>WSOM</td>
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<td>Aerospace Engineering</td>
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<td>Major or Minor</td>
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<td>Dance</td>
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<td>Major or Minor</td>
<td>CAS</td>
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<td>Data Science and Analytics</td>
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<td>Major</td>
<td>CSE</td>
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<td>Individually Designed Major</td>
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### Minor

A minor concentration requires no fewer than 15 credit-hours and normally requires no more than 18 credit-hours. With the exception of minors offered by the Case School of Engineering, students must earn a minimum cumulative average of 2.000 for all courses taken to satisfy minor requirements and for which grades are averaged. Transfer students who wish to complete a minor must complete at Case Western Reserve University at least half the requirements for the minor.

Minors are not required. Students have the option of completing a minor in a discipline other than the major. The successful completion of a minor will be indicated on a student's transcript.

### General Education Requirements

For each degree/major a student must complete, in addition to the SAGES and Physical Education requirements (described in the section General Degree Requirements (p. 1053)), the general education and other requirements for that degree/major (described in the sections of this chapter for the College of Arts and Sciences (CAS) BA degree (p. 1055), the College of Arts and Sciences (CAS) BS degrees (p. 1064), the Case School of Engineering (CSE) BS in Engineering degree (p. 1072), the Case School of Engineering (CSE) BS in Computer Science degree (p. 1073), the Case School of Engineering (CSE) BS in Data Science and Analytics degree (p. 1074), the Weatherhead School of Management (WSOM) (p. 1079), and the Francis Payne Bolton School of Nursing (FPB)).

### Undergraduate General Degree Requirements

#### General Requirements for all Bachelor's Degrees

The bachelor's degree programs require students to study one field in depth (the major) and to complete general education requirements as appropriate to the major field and degree program selected. There is overlap among general education requirements, which allows students flexibility in the choice of majors and degree programs.

Every candidate for a baccalaureate degree from the university must:

1. complete the requirements of the Seminar Approach to General Education and Scholarship (SAGES), as described below;
2. complete two semesters of physical education through a combination of half and/or full semesters in Physical Education activity courses, as described below;
3. complete the requirements of the major field of study, as described in the relevant sections of this Bulletin;
4. complete the general education requirements of the school and degree program in which the student’s major field of study falls, as described in the relevant section of this chapter of the Bulletin (Arts and Sciences (p. 1055), Engineering (p. 1072), Management (p. 1075), Nursing (p. 1076));
5. complete a course of studies with a cumulative grade point average of no less than 2.000 for work taken at Case Western Reserve University; and
6. earn in residence at Case Western Reserve University a minimum of 60 credit-hours, of which at least 15 must be earned after the student has earned a total of 105 credit-hours.

#### Major

All students must complete the requirements of a major field of study. A major ordinarily includes a program of 10 or more courses.

#### Table

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</table>

*Major* - available only as second major for a BA; may be sole major for a BA if also completing a BS (optional)

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**Note:** The table above lists majors and minors offered by Case Western Reserve University for the academic year 2017-2018. The requirements and course offerings may have changed since then. For the most up-to-date information, please refer to the official university bulletin or contact the registrar's office.
SAGES

The Seminar Approach to General Education and Scholarship (SAGES) provides a foundation in critical thinking, written and oral communication, the use of information, quantitative reasoning, engagement with ethical issues and diversity, and exposure to experimental and theoretical approaches to understanding human culture and behavior, scientific knowledge, and methods of research.

The First Seminar

The First Seminar (4 credit-hours, taken in the first semester of enrollment) introduces students to the seminar format through reading, discussion, and intensive writing, and incorporates activities with University Circle institutions. The course focuses on the development of critical thinking and communication skills through the use of a variety of approaches, media, and perspectives to explore the human mind and the nature of inquiry. This course is designed to strengthen writing and analytical skills while building a foundation in ethics, information literacy, and cultural diversity.

Students select a course from:

- First Seminar: Natural World (FSNA 1xx)
- First Seminar: Social World (FSSO 1xx)
- First Seminar: Symbolic World (FSSY 1xx)

As an alternative to these topical seminars, some students may choose FSCC 110: Foundations of College Writing, designed to provide additional writing support.

Students for whom English is a second language and who would benefit from an initial focus on academic English will enroll in FSAE 100: Academic English (3 credit-hours) during the fall semester and then continue with FSCC 100: The Life of the Mind (4 credit-hours) in the spring to complete their First Seminar requirement. Some students for whom English is a second language will go directly into FSCC 100: The Life of the Mind in the fall semester.

*Transfer Students only: Transfer students who have completed the English composition/expository writing requirement with a grade of C or higher at the college/university at which they previously matriculated will receive transfer credit for FSCC 100-TR (3 – 6 credit-hours) and will be required to complete a supplemental 1-credit-hour SAGES introductory seminar – FSTS 100 SAGES Transfer Supplement.

University Seminars

After completion of the First Seminar with a passing evaluative grade and before the end of the second year, students must complete two University Seminars (totaling 6 credit-hours). University Seminars provide continued experience in critical reading, writing, and oral communication, as well as information literacy, ethics, and cultural diversity. Each University Seminar explores content determined according to the interests of the faculty. A student’s First Seminar and two University Seminars must include a course from each of the three thematic areas: Natural World, Social World, and Symbolic World.

Students select courses from:

- University Seminar: Thinking About the Natural World (USNA 2xx)
- University Seminar: Thinking About the Social World (USSO 2xx)
- University Seminar: Thinking About the Symbolic World (USSY 2xx)

Students who complete their First Seminar requirement with FSCC 100, FSCC 110, or FSTS 100 may fulfill the University Seminar requirement by choosing courses from any two of the three thematic areas.

University Composition Requirement: The SAGES Writing Portfolio

Students develop a Writing Portfolio comprised of final graded writing assignments from the First Seminar and University Seminars. The Writing Portfolio is due the semester after completing the final University seminar.

Departmental Seminar

The Departmental Seminar (3 credit-hours), generally taken in the junior year after the completion of the University Seminars, focuses on discipline-specific methods and modes of inquiry and communication characteristic of the Departmental Seminar’s discipline. The Departmental Seminar may be taken in the department of the student’s major or in another department. A course used to fulfill the Departmental Seminar Requirement may not also be used to fulfill a Breadth Requirement. Courses meeting this requirement include the designation “Approved SAGES Departmental Seminar” in their course descriptions. Some majors include a specific Departmental Seminar as part of their requirements.

Senior Capstone

The Senior Capstone assimilates the knowledge and skills gained throughout the educational process. Students engage in a unique one- or two-semester experience (3 - 6 credit-hours) designed in consultation with a faculty member. Each Senior Capstone must include key elements:

1. Demonstration of critical thinking and writing skills;
2. Regular oversight by the Capstone advisor;
3. Periodic reporting of progress;
4. Regular writing (e.g. drafts, progress reports, critiques) throughout the project including a final written report which may be a thesis or equivalent document associated with the project or activity (e.g., such pursuits as performance, experiment, live case analysis, or creative writing), as approved by the department of capstone origin; and
5. Oral reports including a final public presentation at the Senior Capstone Fair, a conference, a performance, a public lecture, a teaching presentation, or another setting, as approved by the department of capstone origin.

Courses meeting this requirement include the designation "Approved SAGES Capstone" in their course descriptions. Some majors include a specific Senior Capstone course as part of their requirements.

Physical Education

All students must complete two full semesters of Physical Education activity courses at zero credit-hours. Students may choose from half-semester and full-semester course offerings. If possible, a student should begin meeting this requirement in the first semester and complete it early in his or her undergraduate years.

Requirements for Specific Degrees

Students are expected to complete a bachelor’s degree in a timely fashion and will ordinarily be subject to the degree requirements in place at the time of matriculation at Case Western Reserve University, although
they may chose to update their requirements to those included in a later General Bulletin.

If a student extends study towards a bachelor’s degree beyond 10 years after first matriculating as an undergraduate student, the major-field department(s) will review the student’s academic record and may update major field requirements. Also, if the student has not already completed the applicable general education requirements in place at the time of matriculation, the appropriate dean in the school offering the major will also review the student’s academic record and may update general education requirements.

Double Majors, Secondary Majors, and Dual Undergraduate Degrees

Only one major is required for a student to satisfy degree requirements, and most students complete their degrees having met the requirements for a single major. However, some students wish to complete more than one major in order to address their interests and academic goals. Several opportunities exist for a student to complete more than one major.

A student may double major in two (or more) Arts and Sciences majors for the BA degree, or two (or more) Engineering majors for the BS in Engineering degree, or two (or more) Management majors for the BS in Management degree. No additional credit-hours beyond those ordinarily required for the specific degree are required, but students may need additional credit-hours to meet all requirements of the two (or more) majors. Students pursuing multiple majors within a single degree will receive one diploma corresponding to the degree earned and each major will be noted on the diploma and the transcript.

A student whose interests span majors that fall under two different degree programs (the BA degree program and a BS degree program or two different BS degree programs) may complete one degree program, including its general education requirements, and the requirements for the two (or more) majors. The major for which the student does not complete the associated general education requirements will be designated as a secondary major. If the field chosen as a secondary major has different requirements for the BA and BS degrees, the requirements to complete the secondary major are those associated with the BA degree. No additional credit-hours beyond those ordinarily required for the degree for which the student completed general education requirements are required, though students may need additional credit-hours to complete all requirements of the two (or more) majors. The student will receive one diploma corresponding to the degree for which the student completed general education requirements, and that degree will be recorded on the transcript. Each major will be noted on the diploma and the transcript, but a secondary major will be designated in that way.

To qualify for two (or more) undergraduate degrees, i.e., a BA and a BS degree or two BS degrees, as a dual degree student, a student must satisfy all requirements for each degree, including each degree’s associated general education requirements, and complete for each additional degree 30 credit-hours of study beyond the hours required for the first degree. Students who seek a dual-degree program that involves the Bachelor of Music degree from the Cleveland Institute of Music must meet Cleveland Institute of Music and Case Western Reserve admission requirements, and must seek approval of both institutions. A student wishing to pursue two degrees is encouraged to meet with a dean in the Office of Undergraduate Studies, 357 Sears Bldg., to discuss requirements.

College of Arts and Sciences
Undergraduate Degree Requirements

Bachelor of Arts Degree

Candidates for the Bachelor of Arts (BA) degree, in addition to meeting the general requirements for bachelor’s degrees (p. 1053), including the SAGES and physical education requirements, must also complete the following requirements:

1. A minimum of 120 credit-hours.
2. No more than 42 credit-hours beyond the 100-level in any one department to be applied to the 120 credit-hour total.
3. At least 90 credit-hours in arts and sciences. These credits may be drawn from those offered by the College of Arts and Sciences, as well as those in economics, biochemistry, nutrition and computer science. (Students completing both a BA and BS degree are exempted from six hours of the 90 credit-hour arts and sciences requirement for the BA.)
4. A minimum of 30 credit-hours of courses at the 300- or 400-level.
5. The General Education Requirements of the College of Arts and Sciences listed below.
6. The requirements for a major listed below as specified in this Bulletin for each department or program. A major requires a minimum of 30 credit-hours, at least 24 of which are taken in the major department or program.
7. For all courses taken in the major department and for which grades are averaged, and for all courses taken to satisfy major requirements and for which grades are averaged, a BA candidate must earn a minimum cumulative average of 2.000. Major requirements include all required and elective work completed in the major department combined with required courses completed in related fields. Transfer students must complete at Case Western Reserve University at least half the credit-hours required in the major department.

Major Concentrations Available for the Bachelor of Arts degree:

- Anthropology
- Art History
- Asian Studies
- Astronomy
- Biochemistry
- Biology
- Chemical Biology
- Chemistry
- Chinese
- Classics
- Cognitive Science
- Communication Sciences
- Computer Science
- Dance
- Dean’s Approved Major**
- Economics
- English
- Environmental Geology
- Environmental Studies*
- Evolutionary Biology*
• French
• French and Francophone Studies
• Geological Sciences
• German
• German Studies
• Gerontological Studies*
• History
• History and Philosophy of Science
• International Studies
• Japanese Studies
• Mathematics
• Music
• Natural Sciences*
• Nutrition
• Nutritional Biochemistry and Metabolism
• Origins Sciences
• Philosophy
• Physics
• Political Science
• Pre-Architecture*
• Psychology
• Religious Studies
• Sociology
• Spanish
• Statistics
• Teacher Education*
• Theater Arts
• Women’s and Gender Studies
• World Literature

* May not be a student’s only major.
** Any student interested in developing for the BA a major of his or her own design may submit, before the end of the sophomore year, a program proposal for a Dean’s Approved Major to the Office of Undergraduate Studies. The Dean of Undergraduate Studies and the Dean of the College of Arts and Sciences must approve any proposed Dean’s Approved Major.

General Education Requirements of the College of Arts and Sciences
These requirements provide a broad foundation for the Bachelor of Arts degree program.

Students pursuing a degree in the College of Arts and Sciences may not fulfill the Departmental Seminar requirement with a course that is being used to fulfill an Arts & Humanities, Social Sciences, or Natural & Mathematical Sciences breadth requirement. A course that has been designated as a Departmental Seminar and that also falls into the Global and Cultural Diversity category may be used to fulfill both requirements.

Course credit earned by Advanced Placement, International Baccalaureate, A-levels and similar programs offered by high schools, by proficiency exams, and by courses taken at domestic and international universities may be applied to elective credit as determined by the academic departments of the College, and may be used to satisfy some general education requirements as described under each heading below.

Breadth Requirements (minimum of six 3- or 4-credit-hour courses, totaling at least 18 credit-hours)
One-half or more of the breadth requirement courses in each breadth area must be taken on campus, except that students transferring from another college or university with 45 or more transferable credits may fulfill their breadth requirements with transfer credit taken at their previous college or university. Credit earned for Advanced Placement, International Baccalaureate, A-levels and similar programs offered in high schools or by proficiency exams may be used to satisfy up to one-half of this requirement if the credit is equivalent to specific courses taught at CWRU. AP, IB, and A-level credit equivalents ending in “TR” may not be used to satisfy the breadth requirements. Pre-matriculation and post matriculation transfer credit for work done at other institutions — for example, at colleges or universities prior to matriculating at CWRU, during the summer, or in an approved Study Abroad program — may be applied to satisfy part of this requirement if approved by the appropriate department.

NOTE: Two courses used to fulfill requirements for the major may be used also to fulfill the breadth requirements.

Arts and Humanities (6 - 8 credit-hours)
Two 3- or 4-credit-hour Arts and Humanities courses selected from:

• Akkadian (AKKD)
• Arabic (ARAB)
• Art History (ARTH)
• Art Studio (ARTS)
• Chinese (CHIN)
• Classics (CLSC)
• Dance (DANC)
• English (ENGL)
• French (FRCH)
• German (GRMN)
• Greek (GREK)
• Hebrew (HBRW)
• History (HSTY)
• Italian (ITAL)
• Japanese (JAPN)
• Latin (LATN)
• Linguistics (LING)
• Music - General (MUGN)
• Music - History (MUHI)
• Music - Theory (MUTH)
• Philosophy (PHIL)
• Portuguese (PORT)
• Religious Studies (RLGN)
• Russian (RUSN)
• Spanish (SPAN)
• Theater (THTR)
• World Literature (WLIT)
Natural and Mathematical Sciences (6 - 8 credit-hours)
Two 3- or 4-credit-hour Natural and Mathematical Science courses selected from:
- Astronomy (ASTR)
- Biochemistry (BIOC)
- Biology (BIOL)
- Chemistry (CHEM)
- Earth, Environmental and Planetary Sciences (EEPS)
- Mathematics (MATH)
- Nutrition (NTRN)
- Physics (PHYS)
- Statistics (STAT)

Social Sciences (6 credit-hours)
Two 3-credit-hour Social Science courses selected from:
- Anthropology (ANTH)
- Cognitive Science (COGS)
- Communication Sciences (COSI)
- Economics (ECON)
- Political Science (POSC)
- Psychology (PSCL)
- Sociology (SOCI)

Quantitative Reasoning (3 - 4 credit-hours)
Each student must complete at least one 3- or 4-credit-hour course identified as a Quantitative Reasoning course selected from the list below. The course used to meet this requirement may also be used to fulfill a major, minor, and/or breadth requirement.

Course credit earned by Advanced Placement, International Baccalaureate, A-levels and similar programs offered at high schools may not be used to satisfy the Global and Cultural Diversity Requirement. Transfer credits for college-level course work done at other institutions — for example, prior to matriculation, during the summer, or in an approved Study Abroad program — may be applied to this requirement if approved by the appropriate department.

Global and Cultural Diversity (3 - 4 credit-hours)
Each student must complete at least one 3- or 4-credit-hour course identified as a Global and Cultural Diversity course selected from the list below. The goal of the Global and Cultural Diversity requirement is to provide students with the opportunity for academic reflection about the variation in human experience. Courses that satisfy this requirement 1) substantively explore one or more cultures outside the United States, or 2) address in a substantive way ethnic, gender, sexual, religious, or other cultural practices within or outside the United States, so as to provide students with fresh perspectives on their own cultural assumptions, traditions, and experiences. The course used to meet this requirement may also be used to fulfill a major, minor, and/or breadth requirement.

Course credit earned by Advanced Placement, International Baccalaureate, A-levels and similar programs offered at high schools may not be used to satisfy the Global and Cultural Diversity Requirement. Transfer credits for college-level course work done at other institutions — for example, prior to matriculation, during the summer, or in an approved Study Abroad program — may be applied to this requirement if approved by the appropriate department.

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Candidates for the Bachelor of Science degrees, in addition to meeting the general requirements for bachelor’s degrees (p. 1053), including the SAGES and physical education requirements, must also complete the following requirements:

1. A minimum of 120-133 credit-hours as specified by the requirements for each BS program.
2. A minimum of 30 credit-hours of courses at the 300- or 400-level.
3. The General Education Requirements of the College of Arts and Sciences listed below. For some BS programs, the General Education Requirements of the College Arts and Sciences have been modified and incorporated into the degree requirements as presented in this bulletin in the section devoted to each department or program.
4. The requirements for a major field listed below as presented in this Bulletin in the section devoted to each department or program.
5. For all courses taken in the major department and for which grades are averaged, a candidate for a BS from the College of Arts and Sciences must earn a minimum cumulative average of 2.000. Major requirements include all required and elective work completed in the major department combined with required courses completed in related fields. Transfer students must complete at Case Western Reserve University at least half the credit-hours required for the major.

**Major Concentrations for the Bachelor of Science degree:**
- Applied Mathematics
- Art Education
- Astronomy
- Biochemistry
- Biology
- Chemistry
- Geological Sciences
- Mathematics
- Mathematics and Physics
- Music Education
- Nutrition
- Nutritional Biochemistry and Metabolism
- Physics
- Statistics
- Systems Biology

**General Education Requirements of the College of Arts and Sciences**

These requirements provide a broad foundation for the Bachelor of Science degree programs.

Students pursuing a degree in the College of Arts and Sciences may not fulfill the Departmental Seminar requirement with a course that is being used to fulfill an Arts & Humanities, Social Sciences, or Natural & Mathematical Sciences breadth requirement. A course that has been designated as a Departmental Seminar and that also falls into the Global and Cultural Diversity category may be used to fulfill both requirements.

Course credit earned by Advanced Placement, International Baccalaureate, A-levels and similar programs offered by high schools, by proficiency exams, and by courses taken at domestic and international universities may be applied to elective credit as determined by the academic departments of the College, and may be used to satisfy some general education requirements as described under each heading below.

**Breadth Requirements (minimum of six 3- or 4-credit-hour courses, totaling at least 18 credit-hours)**

One-half or more of the breadth requirement courses in each breadth area must be taken on campus, except that students transferring from another college or university with 45 or more transferable credits may fulfill their breadth requirements with transfer credit taken at their previous college or university. Credit earned for Advanced Placement, International Baccalaureate, A-levels and similar programs offered in high schools or by proficiency exams may be used to satisfy up to one-half of this requirement if the credit is equivalent to specific courses taught at CWRU. AP, IB, and A-level credit equivalents ending in “TR” may not be used to satisfy the breadth requirements. Pre-matriculation and
post matriculation transfer credit for work done at other institutions — for example, at colleges or universities prior to matriculating at CWRU, during the summer, or in an approved Study Abroad program — may be applied to satisfy part of this requirement if approved by the appropriate department.

NOTE: Two courses used to fulfill requirements for the major may be used also to fulfill the breadth requirements.

**Arts and Humanities (6 - 8 credit-hours)**
Two 3- or 4-credit-hour Arts and Humanities courses selected from:

- Akkadian (AKKD)
- Arabic (ARAB)
- Art History (ARTH)
- Art Studio (ARTS)
- Chinese (CHIN)
- Classics (CLSC)
- Dance (DANC)
- English (ENGL)
- French (FRCH)
- German (GRMN)
- Greek (GREK)
- Hebrew (HBRW)
- History (HSTY)
- Italian (ITAL)
- Japanese (JAPN)
- Latin (LATN)
- Linguistics (LING)
- Music - General (MUGN)
- Music - History (MUHI)
- Music - Theory (MUTH)
- Philosophy (PHIL)
- Portuguese (PORT)
- Religious Studies (RLGN)
- Russian (RUSN)
- Spanish (SPAN)
- Theater (THTR)
- World Literature (WLIT)

**Natural and Mathematical Sciences (6 - 8 credit-hours)**
Two 3- or 4-credit-hour Natural and Mathematical Science courses selected from:

- Astronomy (ASTR)
- Biochemistry (BIOC)
- Biology (BIOL)
- Chemistry (CHEM)
- Earth, Environmental, and Planetary Sciences (EEPS)
- Mathematics (MATH)
- Nutrition (NTRN)
- Physics (PHYS)
- Statistics (STAT)
- Anthropology (ANTH)
- Cognitive Science (COGS)
- Communication Sciences (COSI)
- Economics (ECON)
- Political Science (POSC)
- Psychology (PSCL)
- Sociology (SOCI)

**Quantitative Reasoning (3 - 4 credit-hours)**
Each student must complete at least one 3- or 4-credit-hour course identified as a Quantitative Reasoning course selected from the list below. The course used to meet this requirement may also be used to fulfill a major, minor, and/or breadth requirement.

Course credit earned by Advanced Placement, International Baccalaureate, A-levels and similar programs offered by high schools, by proficiency exams, or by courses taken at domestic colleges and universities or in an approved Study Abroad program may be used to satisfy the Quantitative Reasoning Requirement if the credit is equivalent to a specific CWRU course that satisfies the requirement.

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**Global and Cultural Diversity (3 - 4 credit-hours)**
Each student must complete at least one three- or four-credit-hour course identified as a Global and Cultural Diversity course selected from the list below. The goal of the Global and Cultural Diversity requirement is to provide students with the opportunity for academic reflection about the variation in human experience. Courses that satisfy this requirement 1) substantively explore one or more cultures outside the United States, or 2) address in a substantive way ethnic, gender, sexual, religious, or other cultural practices within or outside the United States, so as to provide students with fresh perspectives on their own cultural assumptions, traditions, and experiences. The course used to meet this requirement may also be used to fulfill a major, minor, and/or breadth requirement.

Course credit earned by Advanced Placement, International Baccalaureate, A-levels and similar programs offered by high schools may not be used to satisfy the Global and Cultural Diversity Requirement. Transfer credits for college-level course work done at other institutions —
for example, prior to matriculation, during the summer, or in an approved Study Abroad program — may be applied to this requirement if approved by the appropriate department.

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<td>SASS 375C</td>
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<td>SASS 375J</td>
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<td>The New Drama in Latin American Literatures</td>
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<td>Afro-Hispanic Literature</td>
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<td>Representations of Black Women and Religion in Film</td>
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<td>Women and Men as Colleagues in Organizations</td>
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<td>WLIT 203</td>
<td>Gods and Heroes in Greek Literature</td>
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<td>WLIT 205</td>
<td>Readings from the Epic of Gilgamesh</td>
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</table>
Case School of Engineering Undergraduate Degree Requirements

Bachelor of Science in Engineering Degree

Candidates for the Bachelor of Science in Engineering (BSE) degree, in addition to meeting the general requirements for bachelor's degrees, including the SAGES and physical education requirements, must also complete the following requirements:

1. A minimum of 128-133 credit-hours as specified by the requirements for each BSE major.
2. The General Education Requirements of the Case School of Engineering listed below.
3. The requirements for the specific engineering major listed below as presented in this Bulletin in the section devoted to each department or program.

Note that most students pursuing a degree from the Case School of Engineering will complete ENGR 398 and ENGL 398 to fulfill the SAGES Departmental Seminar requirement and will complete an engineering senior project in their major to fulfill the SAGES Senior Capstone requirement.

Major Fields Available for the Bachelor of Science in Engineering degree:

- Aerospace Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Computer Engineering
- Electrical Engineering
- Engineering Physics
- Materials Science and Engineering
- Mechanical Engineering
- Polymer Science and Engineering
- Systems and Control Engineering
- Engineering (undesignated)

With the exception of the undesignated major in engineering, all of the engineering programs listed above are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

General Education Requirements of the Case School of Engineering

These requirements provide a foundation in mathematics and sciences for programs in engineering leading to the Bachelor of Science degree. The CSE general education requirements are also designed to develop communication skills and to provide a body of work in the humanities and social sciences.

Course credit earned by Advanced Placement, International Baccalaureate, proficiency examinations, and transfer may be used to satisfy Case School of Engineering general education requirements.
Mathematics, Sciences, and Engineering Requirements (44 credit-hours)

Mathematics 14

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
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<td>Calculus for Science and Engineering II</td>
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Chemistry * 4

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Physics 8

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<td>General Physics I - Mechanics</td>
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<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
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<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
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<td>or PHYS 124</td>
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Engineering 18

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<tr>
<td>ENGR 131</td>
<td>Elementary Computer Programming **</td>
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<td>Introduction to Programming in Java</td>
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<td>ENGR 145</td>
<td>Chemistry of Materials</td>
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<td>Statics and Strength of Materials</td>
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<td>Introduction to Circuits and Instrumentation</td>
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<tr>
<td>ENGR 225</td>
<td>Thermodynamics, Fluid Dynamics, Heat and Mass Transfer ***</td>
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</table>

Total Units 44

* The chemistry-materials course sequence CHEM 105-CHEM 106-ENGR 145 may be substituted for the sequence CHEM 111-ENGR 145.

** Computer engineering and the computer-oriented concentrations in biomedical engineering specifically require EECS 132.

*** Students pursuing a polymer science and engineering major or the biomaterials concentration in the biomedical engineering major may substitute EMAC 351 and EMAC 352 for ENGR 225. Students pursuing majors in aerospace or mechanical engineering may substitute EMAE 251, EMAE 252, and EMAE 353 for ENGR 225.

Natural Sciences, Mathematics, or Statistics Requirement (3 credit-hours)

Course designated by major department.

Humanities and Social Sciences (15 credit-hours)

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<tr>
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<tr>
<td>ENGR 398</td>
<td>Professional Communication for Engineers</td>
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</table>

Total Units 15

Twelve credit-hours comprised of 3- or 4-credit-hour courses *

* Humanities: Akkadian (AKKD), Arabic (ARAB), Art History (ARTH), Art Studio (ARTS), Chinese (CHIN), Classics (CLSC), Dance (DANC), English (ENGL), French (FRCH), German (GRMN), Greek (GREK), Hebrew (HBRW), History (HSTY), Italian (ITAL), Japanese (JAPN), Latin (LATN), Linguistics (LING), Music - General (MUGN), Music - History (MUHI), Music - Theory (MUTH), Philosophy (PHIL), Portuguese (PORT), Religious Studies (RLGN), Russian (RUSN), Spanish (SPAN), Theater (THTR), World Literature (WLIT) and/or Social Sciences: Anthropology (ANTH), Cognitive Science (COGS), Communication Sciences (COSI), Economics (ECON), Political Science (POSC), Psychology (PSCL), Sociology (SOCI), and/or Other Courses that Meet this Requirement for CSE Degree Candidates: Applied Social Sciences (SASS), Bioethics (BETH)

Bachelor of Science in Computer Science Degree

Candidates for the Bachelor of Science in Computer Science degree, in addition to meeting the general requirements for bachelor's degrees (p. 1053), including the SAGES and physical education requirements, must also complete the following requirements:

1. A minimum of 127 credit-hours.
2. The General Education Requirements of the Case School of Engineering as modified for the Bachelor of Science in Computer Science degree and listed below.
3. The requirements for the computer science Bachelor of Science major as presented in this Bulletin.

Note that most students pursuing a degree from the Case School of Engineering will complete ENGR 398 and ENGL 398 to fulfill the SAGES Departmental Seminar requirement and will complete an engineering senior project in their major to fulfill the SAGES Senior Capstone requirement.

General Education Requirements of the Case School of Engineering, modified for the Bachelor of Science in Computer Science degree

These requirements provide a foundation in mathematics and sciences for the Bachelor of Science program in computer science. The CSE general education requirements are also designed to develop communication skills and to provide a body of work in the humanities and social sciences.

Course credit earned by Advanced Placement, International Baccalaureate, proficiency examinations, and transfer may be used to satisfy Case School of Engineering general education requirements.

Mathematics, Sciences, and Engineering Requirements (33 credit-hours)

Mathematics 14

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<td>MATH 121</td>
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<tr>
<td>MATH 122</td>
<td>Calculus for Science and Engineering II</td>
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</table>
Bachelor of Science in Data Science and Analytics Degree

Candidates for the Bachelor of Science in Data Science and Analytics degree, in addition to meeting the general requirements for bachelor's degrees (p. 1053), including the SAGES and physical education requirements, must also complete the following requirements:

1. A minimum of 125 credit-hours.
2. The General Education Requirements of the Case School of Engineering as modified for the Bachelor of Science in Data Science and Analytics degree and listed below.
3. The requirements for the major in data science and analytics as presented in this Bulletin.

Note that most students pursuing a degree from the Case School of Engineering will complete ENGR 398 and ENGL 398 to fulfill the SAGES Departmental Seminar requirement and will complete an engineering senior project in their major to fulfill the SAGES Senior Capstone requirement.

General Education Requirements of the Case School of Engineering, modified for the Bachelor of Science in Data Science and Analytics degree

These requirements provide a foundation in mathematics and sciences for the Bachelor of Science program in data science and analytics. The CSE general education requirements are also designed to develop communication skills and to provide a body of work in the humanities and social sciences.

Course credit earned by Advanced Placement, International Baccalaureate, proficiency examinations, and transfer may be used to satisfy Case School of Engineering general education requirements.

Mathematics, Sciences, and Engineering Requirements (29 credit-hours)

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Total Units: 15

Natural Sciences, Mathematics, or Statistics Requirement (3 credit-hours)

Course designated by major department.

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<tr>
<td>ENGL 398</td>
<td>Professional Communication for Engineers</td>
<td>2</td>
</tr>
</tbody>
</table>

Twelve credit-hours comprised of 3- or 4-credit-hour courses *

Total Units: 15

Humanities and Social Sciences (15 credit-hours)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities: Akkadian (AKKD), Arabic (ARAB), Art History (ARTH), Art Studio (ARTS), Chinese (CHIN), Classics (CLSC), Dance (DANC), English (ENGL), French (FRCH), German (GRMN), Greek (GREK), Hebrew (HBRW), History (HSTY), Italian (ITAL), Japanese (JAPN), Latin (LATN), Linguistics (LING), Music - General (MUGN), Music - History (MUHI), Music - Theory (MUTH), Philosophy (PHIL), Portuguese (PORT), Religious Studies (RLGN), Russian (RUSN), Spanish (SPAN), Theater (THTR), World Literature (WLIT) and/or Social Sciences: Anthropology (ANTH), Cognitive Science (COGS), Communication Sciences (COSI), Economics (ECON), Political Science (POSC), Psychology (PSCL), Sociology (SOCI), and/or Other Courses that Meet this Requirement for CSE Degree Candidates: Applied Social Sciences (SASS), Bioethics (BETH)</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Physics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 121</td>
<td>General Physics I - Mechanics</td>
<td>8</td>
</tr>
<tr>
<td>or PHYS 123</td>
<td>Physics and Frontiers I - Mechanics</td>
<td>8</td>
</tr>
<tr>
<td>PHYS 122</td>
<td>General Physics II - Electricity and Magnetism</td>
<td>8</td>
</tr>
<tr>
<td>or PHYS 124</td>
<td>Physics and Frontiers II - Electricity and Magnetism</td>
<td>8</td>
</tr>
</tbody>
</table>

Total Units: 8

Engineering
Introduction to Programming in Java

Total Units 29

* The chemistry-materials course sequence CHEM 105-CHEM 106-ENGR 145 may be substituted for the sequence CHEM 111-ENGR 145.

Natural Sciences, Mathematics, or Statistics Requirement (3 credit-hours)
Course designated by major department.

Humanities and Social Sciences (15 credit-hours)
ENGL 398 Professional Communication for Engineers 2
ENGR 398 Professional Communication for Engineers 1

Twelve credit-hours comprised of 3- or 4-credit-hour courses 12

Total Units 15

* Humanities: Akkadian (AKKD), Arabic (ARAB), Art History (ARTH), Art Studio (ARTS), Chinese (CHIN), Classics (CLSC), Dance (DANC), English (ENGL), French (FRCH), German (GRMN), Greek (GREK), Hebrew (HBRW), History (HSTY), Italian (ITAL), Japanese (JAPN), Latin (LATN), Linguistics (LING), Music - General (MUGN), Music - History (MUHI), Music - Theory (MUTH), Philosophy (PHIL), Portuguese (PORT), Religious Studies (RLGN), Russian (RUSN), Spanish (SPAN), Theater (THTR), World Literature (WLIT) and/or Social Sciences: Anthropology (ANTH), Cognitive Science (COGS), Communication Sciences (COSI), Economics (ECON), Political Science (POSC), Psychology (PSCL), Sociology (SOCI), and/or Other Courses that Meet this Requirement for CSE Degree Candidates: Applied Social Sciences (SASS), Bioethics (BETH)

Weatherhead School of Management Undergraduate Degree Requirements

Bachelor of Science Degree
Candidates for the Bachelor of Science in Accounting degree or the Bachelor of Science in Management degree, in addition to meeting the general requirements for bachelor’s degrees (p. 1053), including the SAGES and physical education requirements, must also complete the following requirements:

1. A minimum of 122 credit-hours.
2. The General Education Requirements of the Weatherhead School of Management listed below.
3. The requirements for a major in accounting or management as presented in this Bulletin in the section devoted to each department or program.
4. For all courses taken in the major department and for which grades are averaged, and for all courses taken to satisfy major requirements and for which grades are averaged, a candidate for a BS from the Weatherhead School of Management must earn a minimum cumulative average of 2.000. Major requirements include all required and elective work completed in the major department combined with required courses completed in related fields. Transfer students must complete at Case Western Reserve University at least half the hours required for the major.
5. A minimum of 30 credit-hours of courses at the 300- or 400-level.

Majors Available for the Bachelor of Science in Management degree:

- Business Management
- Finance
- Marketing
- Dean’s Approved Major*

*Any student interested in developing a major of his or her own design for the BS in Management should consult with the Office of Undergraduate and Integrated Study Programs in the Weatherhead School of Management.

General Education Requirements of the Weatherhead School of Management (minimum of eight 3- or 4-credit-hour courses, totaling at least 26 credit-hours)
These requirements provide a broad educational foundation for programs in accounting and management, leading to the Bachelor of Science degree.

Course credit earned by Advanced Placement, International Baccalaureate, proficiency examinations, and transfer credit may be used to satisfy Weatherhead School of Management general education requirements.

Two courses used to fulfill requirements for the major may be used also to fulfill the breadth requirements.

Arts and Humanities (6 - 8 credit-hours)
Two 3- or 4-credit-hour Arts and Humanities courses selected from:

- Akkadian (AKKD)
- Arabic (ARAB)
- Art History (ARTH)
- Art Studio (ARTS)
- Chinese (CHIN)
- Classics (CLSC)
- Dance (DANC)
- English (ENGL)
- French (FRCH)
- German (GRMN)
- Greek (GREK)
- Hebrew (HBRW)
- History (HSTY)
- Italian (ITAL)
- Japanese (JAPN)
- Latin (LATN)
- Linguistics (LING)
- Music - General (MUGN)
- Music - History (MUHI)
- Music - Theory (MUTH)
- Philosophy (PHIL)
- Portuguese (PORT)
- Religion (RLGN)
• Russian (RUSN)
• Spanish (SPAN)
• Theater (THTR)
• World Literature (WLIT)

Natural and Mathematical Sciences (14 - 16 credit-hours)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 125</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 126</td>
<td>Math and Calculus Applications for Life, Managerial, and Social Sci II</td>
<td>4</td>
</tr>
</tbody>
</table>

Two natural sciences courses * 6-8
Total Units 14-16

* Any two 3- or 4-credit-hour natural science courses selected from:
  • Astronomy (ASTR)
  • Biochemistry (BIOC)
  • Biology (BIOL)
  • Chemistry (CHEM)
  • Earth, Environmental, and Planetary Sciences (EEPS)
  • Nutrition (NTRN)
  • Physics (PHYS)

Social Sciences (6 credit-hours)

Any two 3- or 4-credit-hour Social Science courses except ECON 102 Principles of Microeconomics* or ECON 103 Principles of Macroeconomics* selected from:

• Anthropology (ANTH)
• Cognitive Science (COGS)
• Communication Sciences (COSI)
• Economics (ECON)
• Political Science (POSC)
• Psychology (PSCL)
• Sociology (SOCI).

* ECON 102 Principles of Microeconomics and ECON 103 Principles of Macroeconomics are included in accounting, business management, finance, and marketing major requirements, as well as the requirement for a WSOM dean’s approved major.

Frances Payne Bolton School of Nursing Undergraduate Degree Requirements

Bachelor of Science in Nursing Degree

Candidates for the Bachelor of Science in Nursing (BSN) degree, in addition to meeting the general requirements for bachelor’s degrees (p. 1053), including the SAGES and physical education requirements, must also complete the following requirements:

1. A minimum of 125.5 credit-hours.
2. The General Education Requirements of the Frances Payne Bolton School of Nursing listed below.
3. The requirements for the major in nursing as presented in this Bulletin.
4. For all courses specifically required for the major in nursing, a minimum grade of C.

Note that most Nursing students will complete NURS 320 Theoretical and Evidence Bases for Best Practice in Nursing to fulfill the SAGES Departmental Seminar requirement and will complete NURS 373 Global Health Practicum to fulfill the SAGES Senior Capstone requirement. Also, most Nursing students will complete NURS 277 upon matriculation to count as a half-semester of Physical Education credit; this course may be used again two years later for a second half-semester of Physical Education credit.

General Education Requirements of the Frances Payne Bolton School of Nursing (minimum of ten 3- or 4-credit-hour courses, totaling at least 30 credit-hours)

These requirements provide a broad educational foundation for the Bachelor of Science in Nursing program.

Course credit earned by Advanced Placement, International Baccalaureate, proficiency examinations, and transfer credit may be used to satisfy School of Nursing general education requirements.

Arts and Humanities (6 - 8 credit-hours)

Two 3- or 4-credit-hour Arts and Humanities courses selected from:

• Akkadian (AKKD)
• Arabic (ARAB)
• Art History (ARTH)
• Art Studio (ARTS)
• Chinese (CHIN)
• Classics (CLSC)
• Dance (DANC)
• English (ENGL)
• French (FRCH)
• German (GRMN)
• Greek (GREK)
• Hebrew (HBRW)
• History (HSTY)
• Italian (ITAL)
• Japanese (JAPN)
• Latin (LATN)
• Linguistics (LING)
• Music - General (MUGN)
• Music - History (MUHI)
• Music - Theory (MUTH)
• Philosophy (PHIL)
• Portuguese (PORT)
• Religious Studies (RLGN)
• Russian (RUSN)
• Spanish (SPAN)
• Theater (THTR)
• World Literature (WLIT)

Natural and Mathematical Sciences (18 credit-hours)

Mathematical Reasoning and Analysis *
To be eligible for the senior year in professional studies privilege, a student must:

1. Be accepted for admission to professional studies at Case Western Reserve University.

2. Meet the following degree requirements:

   a. Completion of the SAGES requirements, the General Education Requirements of the College of Arts and Sciences, and the physical education requirement.

   b. Completion of three-fourths of the courses required for the major, including three-fourths of the courses required in the major department. [If the student has not completed major requirements at the time of receiving the BA, the degree will be awarded without a major.]

   c. Completion of 84 credit-hours of arts and sciences courses. These credit-hours may be drawn from those offered by the College of Arts and Sciences, as well as those in economics, biochemistry, nutrition, or computer science.

   d. Completion of at least 90 credit-hours of academic work, of which the final 60 credit-hours must have been in residence. A student may include in that final 60 credit-hours no more than six credit-hours earned in courses completed in other institutions, either by cross-registration in regular sessions or by approved transient registration in summer sessions.

Upon admission to the program, students register in the professional school to which they have been admitted and are subject to the policies, rules and regulations of the professional school. They may, however, continue to receive CWRU undergraduate scholarships and may continue to reside in undergraduate housing during what would normally be their senior year of undergraduate work. They will be considered professional school students with respect to the awarding of need-based aid.

For information, contact the Office of Undergraduate Studies (ugstudies@case.edu), 357 Sears Bldg., 216.368.2928.

**Senior Year in Absentia Privilege for Students of Medicine and Dentistry**

Students of outstanding ability and attainment who are candidates for the BA degree and are offered admission to a medical or dental school other than those at Case Western Reserve University at the end of the junior year are eligible to shorten their entire course of studies by one year through the Senior Year in Absentia privilege. Application for this privilege should be made during the second semester of the junior year through the dean of undergraduate studies.

A student granted the Senior Year in Absentia privilege is permitted to substitute the work of the first year in a professional school for that required during the last year in the undergraduate college. Upon the satisfactory completion of the first year's work in the professional school, the student will be granted the BA from the College of Arts and Sciences.

The privilege is extended to qualified students who attend medical schools in the United States or Canada approved by the Association of American Medical Colleges or dental schools in the United States approved by the American Association of Dental Schools.

To be eligible for the Senior Year in Absentia privilege, a student must:

1. Be accepted for admission to professional studies.

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### Programs Toward Graduate or Professional Degrees

#### Acceleration Toward Professional Degrees

**Senior Year in Professional Studies at Case Western Reserve University**

Students of outstanding ability and attainment who are candidates for the BA and who are admitted to professional studies at Case Western Reserve University by the end of the junior year are offered an opportunity to shorten their entire course of studies by one year through the Senior Year in Professional Studies privilege. Application should be made during the second semester of the junior year through the dean of undergraduate studies. This privilege is extended to students who are candidates for the BA and who attend the School of Dental Medicine; the School of Law; the Frances Payne Bolton School of Nursing; or the Jack, Joseph and Morton Mandel School of Applied Social Sciences of Case Western Reserve University.

A student granted the senior year in professional studies privilege is permitted to substitute the work of the first year in a professional school for that required during the last year as an undergraduate. Upon the satisfactory completion of the first year's work in the professional school, the student will be granted the bachelor's degree from the College of Arts and Sciences.

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### Summary of Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSCL 282</td>
<td>Quantitative Methods in Psychology</td>
<td>3</td>
</tr>
<tr>
<td>STAT 201</td>
<td>Basic Statistics for Social and Life Sciences</td>
<td>3</td>
</tr>
<tr>
<td>or STAT 201R</td>
<td>Basic Statistics for Social and Life Sciences Using R Programming</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 114</td>
<td>Principles of Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 116</td>
<td>Introduction to Human Anatomy and Physiology I</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 117</td>
<td>Introduction to Human Anatomy and Physiology II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 119</td>
<td>Concepts for a Molecular View of Biology I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 121</td>
<td>Concepts for a Molecular View of Biology II</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Units**

- **Social Science course**
  - SOCI 203: Human Development: Medical and Social 3 units
  - **Total Units: 18**

- **Natural Science course**
  - BIOL 114: Principles of Biology 15 units
  - BIOL 116: Introduction to Human Anatomy and Physiology I 15 units
  - BIOL 117: Introduction to Human Anatomy and Physiology II 15 units
  - CHEM 119: Concepts for a Molecular View of Biology I 15 units
  - CHEM 121: Concepts for a Molecular View of Biology II 15 units

- **Total Units: 15**

- **Total Units: 6**

* Students choose one of these four courses. A student who successfully completes one of these courses is not eligible to enroll in any of the other three.

** Any 3-credit-hour course selected from: Anthropology (ANTH), Cognitive Science (COGS), Communication Sciences (COSI), Economics (ECON), Political Science (POSC), Psychology (PSCL), or Sociology (SOCI).
2. Attain a cumulative grade point average of at least 3.200 in all courses attempted from the date of admission as an undergraduate.

3. Meet the following degree requirements:
   a. Completion of the SAGES requirements, the General Education Requirements of the College of Arts and Sciences, and the physical education requirement.
   b. Completion of three-fourths of the courses required for the major, including three-fourths of the courses required in the major department. [If the student has not completed major requirements at the time of receiving the BA, the degree will be awarded without a major.]
   c. Completion of 84 credit-hours of arts and sciences courses. These credits may be drawn from those offered by the College of Arts and Sciences, as well as those in economics, biochemistry, nutrition, or computer science.
   d. Completion of at least 90 credit-hours of academic credit, of which the final 60 credit-hours must have been in residence. A student may include in that final 60 credit-hours no more than six credit-hours earned in courses completed in other institutions, either by cross-registration in regular sessions or by approved transient registration in summer sessions.

For information, contact the Office of Undergraduate Studies (ugstudies@case.edu), 357 Sears Bldg., 216.368.2928.

**Integrated BS in Accounting/Master of Accountancy (MAcc)**

The Integrated BS in Accounting/Master of Accountancy (MAcc) program allows students to work towards the completion of the Master of Accountancy (https://weatherhead.case.edu/degrees/masters/ma-accountancy) during their undergraduate studies, thereby enabling completion of both degrees in as little as four years. If after completion of the BS an additional semester is needed to complete the MAcc or if a student chooses to complete a majority of the MAcc in a fifth year, the student will enroll solely as a graduate student in the Weatherhead School of Management to complete the master’s degree. Depending on the student’s academic record and total credit-hours completed, he or she may choose to count up to six credit-hours (two courses) towards both the BS and the MAcc.

This program is strongly recommended for students planning to obtain professional certification as a certified public accountant (CPA). CPA candidates must have completed 150 credit-hours of study at the university level in order to qualify to sit for the CPA examination. The integrated program can save qualified students both time and money while equipping them with the skills and knowledge attractive to top accounting firms.

Because of the necessity for proper planning of coursework and programs, undergraduate students are strongly encouraged to apply for the Master of Accountancy in the junior year. Weatherhead undergraduates must apply for and be admitted to the MAcc program, but certain requirements are waived, such as the Graduate Management Admission Test (GMAT). Once admitted, students in the integrated study program are required to design a comprehensive study plan with both their Weatherhead undergraduate advisor and the faculty director of the MAcc program.

For more information, contact Tiffany Welch (tiffany.welch@case.edu), assistant dean of undergraduate and integrated study programs, at 216.368.2058 or Ashley Lu (jingwen.lu@case.edu), program manager for the MAcc, at 216.368.5376.

**Integrated BA/BS and MSM-Finance or MSM-Operations Research & Supply Chain Management**

The Integrated Bachelor of Arts or Bachelor of Science and Master of Science in Management Finance (https://weatherhead.case.edu/degrees/masters/ms-management/finance) (MSM-Finance) or Master of Science in Management-Operations Research & Supply Chain Management (https://weatherhead.case.edu/degrees/masters/ms-management/operations-research-supply-chain) (MSM-OR/SC) program allows qualified CWRU undergraduates to work towards the completion of a specialty master’s degree from the Weatherhead School of Management (i.e. MSM-Finance or MSM-OR/SC) during their undergraduate studies, thereby enabling completion of both degrees in as little as four years. If after completion of the BA or BS an additional semester is needed to complete the MSM-Finance or MSM-OR/SC, or if a student chooses to complete a majority of the MSM-Finance or MSM-OR/SC in a fifth year, the student will enroll solely as a graduate student in the Weatherhead School of Management to complete the master’s degree.

Students admitted to the program are permitted to take up to nine credit-hours of graduate level courses toward the MSM-Finance or MSM-OR/SC while an undergraduate and count these credit-hours towards both the undergraduate degree (as appropriate to the student’s undergraduate degree program) and the graduate degree (MSM-Finance or MSM-OR/SC).

**Admission to Weatherhead’s specialty master’s programs** (https://weatherhead.case.edu/degrees/#specialty) is based on academic preparation and achievement (undergraduate coursework and GPA), GMAT/GRE or SAT scores, and genuine interest in finance or operations research/supply chain management (determined by application essays, letters of recommendation, and interview).

For more information about these integrated study programs, contact Jim Hurley (james.hurley@case.edu), assistant dean of undergraduate and integrated programs, at 216.368.3856; or Marybeth Keeler (marybeth.keeler@case.edu), program manager of the MSM-Finance program, at 216.368.3688; or Matthew Maloney (matthew.maloney@case.edu), program director for the MSM-OR/SC program. For more information about applying to specialty master’s programs in the Weatherhead School of Management, contact Meredith Richardson (meredith.richardson@case.edu) at 216.368.2069.

**Acceleration Toward Graduate Study**

**Integrated Graduate Studies Program**

The Integrated Graduate Studies Program (IGS) is intended for highly motivated undergraduate students who are candidates for the BA degree and whose objective is a degree at the master’s or doctoral level. Qualified students may apply in the junior year to be admitted to graduate study for their senior year and pursue the simultaneous completion of requirements for both the master’s and bachelor’s degrees.

The baccalaureate will normally be awarded upon completion of the requirements for both degrees, unless a student satisfies all BA requirements prior to completing the master’s degree requirements. Students in the IGS Program are exempted from the 42-hour restriction imposed on BA candidates for work above the 100-level in a single
Eligibility requirements for participation in the Integrated Graduate Studies Program are:

1. 90 credit-hours earned of which the last 60 credit-hours must have been in residence at Case Western Reserve University.
2. Completion of the SAGES requirements, the General Education Requirements of the College of Arts and Sciences, and the physical education requirement; students who have fulfilled all SAGES requirements except the Senior Capstone will be required to complete the capstone during their first year in the IGS program.
3. Completion of three-fourths of the requirements for the major, including three-fourths of the courses required in the major department.
4. Admission to a master’s or doctoral program offered through the School of Graduate Studies.

Upon admission to the program, IGS students register as students in the School of Graduate Studies and are subject to the policies, rules and regulations of the School of Graduate Studies. They may, however, continue to receive CWRU undergraduate scholarships and may continue to reside in undergraduate housing during what would normally be their senior year of undergraduate work. They will be considered graduate students with respect to the awarding of need-based aid.

For information, contact the Office of Undergraduate Studies (ugstudies@case.edu), 357 Sears Bldg., 216.368.2928.

Integrated BS/MS in Nutrition
Admission to the Integrated BS/MS in Nutrition program is subject to the same process and requirements as admission to the Integrated Graduate Studies Program described above. Upon successful completion of the program, students earn the BS in Nutrition and the MS in Nutrition.

BS/MS Program for Candidates for the BS in Engineering, Computer Science, Mathematics, Natural Sciences, and Statistics
The Integrated BS/MS Program is intended for highly motivated candidates for the BS in engineering, computer science, mathematics, natural sciences, or statistics who wish to pursue an advanced degree. Application to the BS/MS program must be made in the junior year and prior to attaining senior status (completion of 90 credit-hours). Generally, this means that a student will submit the application during his or her sixth semester of undergraduate course enrollment and will have no fewer than two semesters of remaining BS requirements to complete.

A student admitted to the program may, in the senior year, take up to nine credit-hours of graduate courses (400-level and above) that will count towards both BS and MS requirements. The courses to be double-counted must be specified at the time of application. Courses taken prior to admission to the program cannot count towards the MS unless they are in excess of BS degree requirements and permission to use them towards the MS has been granted by the dean of graduate studies and the dean of undergraduate studies.

To be considered for the BS/MS Program, a student must:

1. submit to the School of Graduate Studies an application for admission to the program, and
2. submit to the Office of Undergraduate Studies an MS Planned Program of Study Form, showing the courses to be double-counted.

Students for whom the master’s project or thesis is a continuation and development of the senior project should register for Exxx 651 Thesis (or the appropriate project course) during the senior year and are expected to complete all other courses for the BS before enrolling in further MS course work and thesis (continuing the senior project). Students for whom the master’s thesis or project is distinct from the senior project will be expected to complete the BS degree before taking further graduate courses for the master’s degree.

Applicants in engineering or computer science should consult their departmental BS/MS advisor in the Case School of Engineering. Applicants in mathematics, natural sciences, and statistics should consult the Office of Undergraduate Studies.

Conditionally Guaranteed Admission to the University’s Professional Schools
The Pre-Professional Scholars Programs in Medicine and Dentistry grant to a few outstanding entering first-year undergraduates conditional commitments of admission to the corresponding professional school at Case Western Reserve University. These commitments are honored upon successful completion of the requirements established by each professional school. Students admitted to these programs are relieved of much of the anxiety and uncertainty associated with pre-professional studies. Consequently, they feel free to undertake challenging courses of study and pursue a variety of interests as they prepare for professional studies. Pre-Professional Scholars in Medicine are free to choose any of the bachelor’s degrees available in the University. Pre-Professional Scholars in Dentistry are not required to complete a bachelor’s degree, but may elect to do so in any of the bachelor’s degrees available.

Participants who wish to change their career goals or apply for admission to other professional schools are free to do so.

[The Pre-Professional Scholars Programs in Law and in Social Work and the six-year Dental program are no longer available, effective for students matriculating as undergraduate in Fall 2017 or later.]

Pre-Professional Scholars Program in Dentistry
Each year, approximately 10 exceptionally well-qualified high school seniors who plan to pursue careers in dentistry are offered places in the Pre-Professional Scholars Program in Dentistry. This program requires seven years: three years of successful undergraduate study and four years at the School of Dental Medicine.

Pre-Professional Scholars in Dentistry are not required to complete a major, but if they elect to earn a bachelor’s degree they are free to choose a major in an area of interest. Students who elect to complete a bachelor’s degree must either complete all degree requirements by the end of their third year or switch to the Senior Year in Professional Studies (p. 1077) program, which permits them to substitute the work of the first year in dental school for that required during the last year as an undergraduate pursuing a Bachelor of Arts. Students who switch to the Senior Year in Professional Studies program in order to complete their bachelor’s degree will not lose their conditional admission to the School of Dental Medicine, but they are expected to complete all requirements for the Pre-Professional Scholars Program.

To qualify for the place reserved in the School of Dental Medicine, a Pre-Professional Scholar in Dentistry must achieve the following:
1. A cumulative grade point average of 3.500 or higher for all coursework, as well as for all science coursework taken, including, but not exclusively, biology, chemistry, physics, and mathematics.
2. A Perceptual Ability score of 18 or higher and an Academic Average score of 19 or higher on the Dental Admission Test (DAT) of the American Dental Association. The test must be taken no later than October of the third year.
3. Successful completion of the following courses, with a minimum of 30 credit-hours in biology, chemistry, physics, and mathematics taken at Case Western Reserve University:

   **Biology:**
   - BIOL 214 & 214L: Genes, Evolution and Ecology and Genes, Evolution and Ecology Lab
   - BIOL 215 & 215L: Cells and Proteins and Cells and Proteins Laboratory
   - BIOL 216 & 216L: Development and Physiology and Development and Physiology Lab

   **Chemistry:**
   - CHEM 105: Principles of Chemistry I
   - CHEM 106: Principles of Chemistry II
   - CHEM 113: Principles of Chemistry Laboratory
   - CHEM 223: Introductory Organic Chemistry I
   - CHEM 224: Introductory Organic Chemistry II
   - CHEM 233: Introductory Organic Chemistry Laboratory I
   - CHEM 234: Introductory Organic Chemistry Laboratory II

   **Mathematics:**
   - MATH 125: Math and Calculus Applications for Life, Managerial, and Social Sci I

   **Physics:**
   - PHYS 115: Introductory Physics I
   - PHYS 116: Introductory Physics II

4. Successful completion of a SAGES First Seminar, two University Seminars, a SAGES writing portfolio, at least one course in the arts and humanities, at least one course in the social sciences, and two semesters of physical education.
5. A successful transition interview with faculty representing the School of Dental Medicine's admissions committee, usually scheduled after the receipt of grades from the fall semester of the third year.

**Pre-Professional Scholars Program in Medicine**

Each year, 15 to 20 exceptionally well-qualified high school seniors who plan to pursue careers in medicine are offered places in the Pre-Professional Scholars Program in Medicine. Pre-Professional Scholars receive a conditional commitment of admission to the University Program of the Case Western Reserve University School of Medicine to be honored upon successful progress toward and completion of the bachelor's degree. The Pre-Professional Scholars Program in Medicine requires eight years: four years of successful undergraduate study leading to the bachelor’s degree followed by four years in the University Program of the School of Medicine. Pre-Professional Scholars in Medicine who complete their undergraduate degree requirements in fewer than four years are required to pursue other experiences intended to enhance their professional and personal development during the period following the receipt of their bachelor’s degree and until study at the School of Medicine begins.

Pre-Professional Scholars in Medicine are free to choose from among all of the degree and major programs offered in the university, but must complete the courses in biochemistry, biology, chemistry, physics, mathematics/statistics, and behavioral sciences listed in the Conditions of Admission letter they received when accepted to the program.

Pre-Professional Scholars are expected to demonstrate successful academic progress by meeting the following level of performance: A CWRU cumulative GPA of 3.63 and a cumulative American Medical College Application Service (AMCAS) GPA and AMCAS Biology, Chemistry, Physics and MATH (BCPM) GPA of 3.63 at the time of application and maintained on final graduation transcripts. They are also expected to continue to fulfill expectations for outstanding professional and personal development as outlined in the Condition of Admission letter. These expectations include, but are not limited to, maintaining academic integrity and adhering to the university's standards of conduct (all academic integrity and judicial offenses will be reported to the School of Medicine), clinical shadowing, and involvement in undergraduate activities and community programs.

Pre-Professional Scholars in Medicine are not required to take the Medical College Admission Test (MCAT) for the program. However, if they do take the MCAT, they are expected to achieve a score that is above the 94th percentile. Program participants who have an interest in applying to other medical schools or who wish to be considered for a dean's merit scholarship at the Case Western Reserve School of Medicine should plan on taking this test.

Progress is reviewed with each student at regular intervals in the program. At the end of the third year, Pre-Professional Scholars in Medicine who have met the required levels of performance go through the normal admission procedures for the University Program of the School of Medicine, including submitting an application through the American Medical College Application Service (AMCAS) and an interview. Participants who do not meet the required levels of performance may still be admitted into the University Program of the School of Medicine, but such admission will be subject to review and approval by the School of Medicine's Admissions Committee.

Successful completion of the Pre-Professional Scholars Program in Medicine guarantees admission only to the University Program of the School of Medicine. Students seeking admission to the Cleveland Clinic Lerner College of Medicine of the Case Western Reserve University School of Medicine must complete a separate application and will be considered in competition with all applicants for that program.

**Undergraduate Experiential Learning**

Case Western Reserve University offers undergraduates a variety of experiences inside and outside the classroom that are built on a process of guided inquiry, preparation, action and reflection. Many research, internship, and employment opportunities are aligned with academic programs. Linguistic and cultural immersion characterize the study abroad experience. Courses that incorporate community service or internships into the curriculum forge links between Case Western
Reserve undergraduates and schools, neighborhoods, businesses, and governmental and health care institutions in Cleveland and elsewhere.

**Course-Based Experiential Learning**

In many courses, Case Western Reserve students engage in experiential learning beyond the on-campus classrooms and laboratories. Experiences that form the basis for reflection and synthesis under the guidance of faculty include working with hospitalized children, designing engineering solutions for a problem presented by a municipality, interning at a local media outlet, tutoring in Cleveland’s Hispanic community, gaining experience in public health clinics, studying history with “the city as classroom,” or collecting aquatic specimens from the ponds at the university’s 389-acre farm.

**International Experience**

Case Western Reserve University encourages all students to study abroad. Students of all majors are able to study abroad without interfering with their graduation timeline. Many of the study abroad programs cost the same as studying in Cleveland, and financial aid can be used to supplement study abroad costs as needed. Additionally, many students will find that they are eligible for scholarships. Students should visit www.case.edu/studyabroad or contact a study abroad advisor at studyabroad@case.edu to find a program that meets their needs.

**Semester and Academic Year Programs**

Case Western Reserve University partners with several overseas institutions in order to allow students to determine, in consultation with their academic advisor and study abroad advisor, study abroad programs that meet their academic and personal goals. Students can choose from a list of approved study abroad partners (http://www.case.edu/international/edabroad/thinkStudyAbroadLongTerm.html).

Undergraduate students who have completed at least 24 credit-hours of coursework at Case Western Reserve University, have declared a major, and are in good academic and disciplinary standing, with no pending judicial actions, and are otherwise eligible to register on campus at Case Western Reserve University for the proposed semester(s) (no financial holds, e.g.) are eligible to participate in programs of study or practical experience that immerse them in the culture and language of another country.

After matriculation at Case Western Reserve University, students are permitted to earn at other accredited colleges or universities or through an approved program of study abroad no more than 38 credit-hours toward the totals required for the degree, including courses taken through the cross-registration program, with no more than 15 credit-hours taken as part of domestic programs or as summer study in a student’s home country; any off-campus study credits beyond 15 may only be taken through approved study abroad programs. Any additional credit earned at other institutions after matriculation at Case Western Reserve beyond 15 domestically or as summer study in a student’s home country and beyond a total of 38 including study abroad will raise the total number of credit-hours required for the degree by a corresponding number.

Case Western Reserve does not require students to complete any foreign language prerequisites before studying abroad, though students wishing to study in a country where the native language is not English are advised to develop their language skills to the extent possible. However, students studying for at least a semester in a single location where English is not an official language must take a course that advances their skills in a language of the host country during each semester of study abroad, provided such courses are available; this may be a course of language instruction or a course taught in a language of the host country.

Students participating in study abroad experiences that are comparative in nature and visit several sites within the same semester are not required to include language study in their academic programs.

Students participating in semester or academic year study abroad must enroll in the equivalent of at least 12 credit-hours each semester in order to maintain full-time student status for the semester abroad. Upon presentation of an official transcript from the study abroad program, transfer credit will be awarded for courses determined to be equivalent or comparable to those offered by the appropriate academic department at Case Western Reserve University and completed with a grade of C or better.

Students participating in semester or academic year study abroad pay tuition to Case Western Reserve University and maintain their student status during the period of study abroad. Case Western Reserve University will, in turn, pay the tuition costs for the student’s program, but the student will be responsible for all non-tuition costs associated with study abroad. Students eligible for financial aid continue their eligibility during study abroad. For more information, contact a study abroad advisor by emailing studyabroad@case.edu.

**CWRU in London at the Royal Academy of Dramatic Art**

CWRU in London (http://case.edu/international/office-of-education-abroad/programs/london.html) at the Royal Academy of Dramatic Art allows students to travel in a cohort to London to study theater and theater history. This theater/humanities program, offered in conjunction with the Royal Academy of Dramatic Art, allows students to sharpen their acting skills and gain a solid understanding of theatrical history while living and studying alongside some of the world’s best performing artists. Because students are formally enrolled in CWRU courses while participating in this program, their courses and grades appear on the CWRU transcript in the ordinary way rather than as transfer credit.

**Short-Term Programs**

Case Western Reserve University offers a robust portfolio of short-term study abroad options, which allow students to travel as a group with a member of the Case Western Reserve University faculty. These programs are often one to three weeks in duration and are offered over Spring Break, Winter Break, and during the summer. Program offerings vary each year, but recent short-term study abroad locations included Botswana, China, Costa Rica, Cuba, Ecuador, France, Germany, Guatemala, Israel, the Netherlands, Poland, Spain, and the United Kingdom. All CWRU students in good academic and disciplinary standing are eligible to participate in short-term study abroad programs. For more information, contact a study abroad advisor by emailing studyabroad@case.edu.

**Summer Programs**

All Case Western Reserve University undergraduates in good academic and disciplinary standing are permitted to study abroad during the summer. With approval, up to 15 credit-hours of summer coursework can be transferred to Case Western Reserve University. In the summer, study abroad students pay tuition and fees directly to the school/provider overseas. A wide variety of summer programs is available through the Office of Education Abroad. For more information, contact a study abroad advisor by emailing studyabroad@case.edu.

**Research, Service Learning, and Internship Opportunities Abroad**

Case Western Reserve University offers research, service learning, and internship opportunities abroad as part of a semester abroad on many
of our approved programs, as well as a research-intensive programs in partnership with Acadia University (summer options) and EuroScholars (semester options). The CWRU study abroad advisors can help students identify and apply to these programs. Students can also identify independent research projects abroad with the help of the Office of Education Abroad and CWRU faculty.

Research Experience

**Undergraduate Research**

Case Western Reserve University is a research-intensive community with a historic tradition of involving undergraduates in research and creative endeavors. Regardless of a student’s major or academic interests, there are numerous opportunities to engage in research either on campus with Case Western Reserve faculty or elsewhere during both the academic year and the summer. The SOURCE (http://www.case.edu/provost/source) (Support of Undergraduate Research and Creative Endeavors) Office provides assistance to students throughout the undergraduate educational experience, including:

- helping students identify research and creative project opportunities,
- providing funding for on-campus summer research,
- providing funding for travel for students presenting their work at regional and national conferences,
- providing educational research and informational seminars,
- sponsoring Intersections: SOURCE Symposium and Poster Session for students to present their work to our academic community, and
- advising Discussions: The Undergraduate Research Journal of CWRU.

For more information, email source@case.edu or phone 216.368.8508.

In many cases, students pursuing research under the guidance of a faculty member may earn degree credit by registering for “Undergraduate Research” or “Independent Study” in the appropriate department. These are advanced-level courses and require departmental approval. However, students may not earn both degree credit and pay for the same work. Students may discuss academic credit for research with their major advisor.

Work Experience

**The Center for Civic Engagement and Learning**

The Center for Civic Engagement and Learning (https://students.case.edu/civicengagement) (CCEL) works to create an engaged campus by providing and supporting opportunities for community service and collective action while promoting civic awareness and leadership. CCEL offers a variety of programs, services, and resources to accommodate different student interests and schedules. These include one-day Saturdays of Service, flexible weekly opportunities through CCEL Serves, week-long and weekend Alternative Break experiences, and the year-long Civic Engagement Scholars program. CCEL coordinates Cleveland excursions to explore and connect with our community and facilitates educational training about community issues, responsible engagement, voter education/registration, and active citizenship. CCEL also provides community service advising and assists faculty and students in designing and implementing service learning courses and community-based capstone projects. For more information, visit the Center for Civic Engagement and Learning, Tinkham Veale University Center, Suite 165.

**Cooperative Education**

Cooperative Education (Co-op) (http://engineering.case.edu/coop) is an academic program that enables students in majors offered by the Case School of Engineering to alternate classroom studies with career-based experiences in industry. It is a learning experience designed to integrate classroom theory with practical experience and professional development. Co-op is a paid full-time work experience designed to enhance the student’s education. Case Western Reserve co-op assignments are typically for two seven-month periods, each period consisting of a summer and a contiguous spring or fall semester. While participating in co-op, students maintain their full-time student status. This program is available to students pursuing majors in all fields of engineering, computer science (BA and BS), and data science. For additional information, contact the Division of Engineering Leadership and Professional Practice office, Nord Hall, Room 312, 216.368.5119.

**Professional Practicum**

Practicum (http://students.case.edu/careers/students/jobs/practicums) is an experiential learning collaboration among a student, an employer, and a faculty member serving as the student’s practicum advisor that is coordinated by the Career Center’s Experiential Learning Specialist. The program is open to undergraduate students enrolled in the College of Arts and Sciences and/or the Weatherhead School of Management. The primary goal of a practicum is the intellectual, personal, and professional growth of the student. In order to ensure that this goal is achieved, the collaborators establish learning objectives prior to the start of the practicum. These objectives are reviewed throughout the semester, and the student’s progress is evaluated at both the mid-point and end of the practicum.

While completing a practicum assignment, a student works full-time for a minimum of 14 weeks in a professional setting and does not take classes. The student will maintain full-time student status during the practicum period. Though credit is not awarded, students who successfully complete the practicum assignment will receive transcript notation. A student may participate in up to two practica, but it is recommended that at least one semester be spent on campus between these experiences. Students interested in participating in a practicum should contact the Career Center a semester prior to the intended practicum assignment.

**Washington Study Program**

The Washington Study Program (http://politicalscience.case.edu/undergraduate/washington-center-program) provides students with the opportunity to complete a full-time, research-intensive internship in Washington, D.C. By participating in a semester-length program during the fall or spring (WASH 2A (p. 534) Washington Center Internship), students earn 9 credit-hours; for a summer internship (WASH 2D (p. 534) Washington Center Summer Internship), they earn 3 credit-hours. In addition, students earn 3 credit-hours for participating in a seminar and attending a weekly lecture/discussion group (WASH 2B (p. 534) Washington Center - Politics and Public Policy Course) and 3 credit-hours by developing a portfolio based on their internship experiences (WASH 2C (p. 534) Washington Center - Portfolio). The credits earned can be counted as general electives or applied to a student’s major or minor with the prior consent of the individual department(s).

To be eligible for the program, a student is expected to be a junior or senior and have a GPA of at least 3.00. The program director (Professor Justin Buchler justin.buchler@case.edu), 111 Mather House, 216.368.2646), the student’s major advisor, and the appropriate dean must approve each application. Students must ensure that their
participation will not prevent them from meeting on-campus residency or other university requirements.

**Undergraduate Collaborative Programs**

**Collaborative Programs with Other Colleges and Universities**

**Cross Registration in Northeast Ohio**

Full-time undergraduates in good academic standing may cross-register for one course per semester at no additional tuition cost beyond their Case Western Reserve University tuition at the Cleveland Institute of Art, Cleveland State University, Cleveland Institute of Music, or John Carroll University. Cross-registration at other local colleges and universities while enrolled full-time at Case Western Reserve will be considered on a case-by-case basis. Approval to participate in cross-registration is handled by the Office of Undergraduate Studies, and is normally limited to courses that are not offered at Case Western Reserve.

To cross-register for studio courses at the Cleveland Institute of Art, a student must have permission from Case Western Reserve University’s director of art studios, Mr. Timothy Shuckerow (timothy.shuckerow@case.edu), 2215 Adelbert Road, 216.368.2714.

**Joint Program in Art Education**

The joint program in art education of Case Western Reserve University and the Cleveland Institute of Art (CIA) enrolls students pursuing the BS in Art Education, combining studio art courses at the Cleveland Institute of Art with liberal arts and education courses at Case Western Reserve University. Admission to the program requires application to Case Western Reserve University and presentation of an art portfolio to the Cleveland Institute of Art; credentials must be acceptable to both institutions.

**Joint Program in Music**

All programs in music are conducted jointly by Case Western Reserve University and the Cleveland Institute of Music, and provide the intimacy and specialization of a professional conservatory, together with the resources of a comprehensive university.

Private music lessons can be arranged through the Department of Music in collaboration with the Cleveland Institute of Music. Students interested in pursuing this opportunity must obtain a permit at the Music Department in Haydn Hall to enroll for credit in Applied Music. Charges for private lessons will be covered by the full tuition rate for music and music education majors only. All other students will pay an additional fee.

Students pursuing a major in music or music education take music theory and lessons at the Cleveland Institute of Music, and take music history and other liberal arts and music education courses at Case Western Reserve University. Students pursuing the Bachelor or Arts degree with a major in music or the Bachelor of Science in Music Education degree apply to and enroll in Case Western Reserve University, while students seeking the Bachelor of Music degree apply to and enroll in the Cleveland Institute of Music.

**Reserve Officer Training Corps (ROTC)**

Reserve Officer Training Corps (ROTC) programs are available to Case Western Reserve University students through cooperative arrangements with Kent State University for Air Force ROTC and with John Carroll University for Army ROTC. Each of these universities offers military studies, leadership, and training courses. Participating students may seek transfer credit at Case Western Reserve for these courses, and may be exempted from the undergraduate physical education requirement. Students who are not recipients of ROTC scholarships may enroll in the first- and second-year ROTC courses without incurring any military obligation. University students enrolling in ROTC programs are eligible to compete for ROTC scholarships awarded by the Air Force or the Army.

**Air Force ROTC**

The Air Force Reserve Officer Training Corps (http://www.kent.edu/afrotc) (AFROTC) program provided by Kent State University prepares students for service as officers in the United States Air Force. Through courses in history, management, and leadership, and through practical training, students acquire leadership and management skills, and learn about Air Force career opportunities, the role of the military in American society, the history of air power, and national defense policy.

An agreement between Case Western Reserve University and Kent State University allows full-time Case Western Reserve students to complete aerospace studies courses. Students cross-register for these courses through Cleveland State University, but the courses are held at Kent State University, which is approximately 35 miles from Case Western Reserve. Classes are usually scheduled on one or two afternoons during the week. This arrangement allows Case Western Reserve students to participate in either the four- or two-year AFROTC program. Students who wish to enter the two-year program in the junior year must contact the professor of aerospace studies no later than February prior to the academic year of planned entry.

Air Force ROTC scholarships are available on a competitive basis. Information about courses, registration, and scholarships may be obtained from the Air Force ROTC DET 630, 125 Terrace Drive, Kent State University, Kent, Ohio 44242; telephone: 330-672-2182. Case Western Reserve students planning to register for AFROTC courses at Kent State University should consult with the Office of Undergraduate Studies for information regarding registration procedures.

**Army ROTC**

The Army ROTC (http://www.jcu.edu/rotc) program is designed to prepare students for service as a commissioned Army officer in either the active duty U.S. Army or the reserve components of the Army Reserve or National Guard. Classes and practical training focus on military skills, officer professionalism, leadership training, and the development of military-related officer and management techniques and procedures.

The Army ROTC program is offered through a partnership agreement with the US Army and a cooperative arrangement with John Carroll University with some of the first- and second-year ROTC classes being offered on the Case Western Reserve University campus. For those courses offered at Case Western Reserve (MLSC 101, MLSC 102, MLSC 201, and MLSC 202), students register in the ordinary way. For other Army ROTC classes, students enroll through cross-registration in the Department of Military Science at John Carroll University, which is approximately five miles from Case Western Reserve.

Army ROTC scholarships are available on a competitive basis. Information about courses, registration, and scholarships may be obtained from the Department of Military Science (ARMY-ROTC), John Carroll University, University Heights, OH 44118-4581; telephone: 216.397.4421. Case Western Reserve students planning to register for Army ROTC courses at John Carroll University should consult with the
Office of Undergraduate Studies for information regarding registration procedures.

**Fisk University Exchange Program**

An exchange program between Fisk University and Case Western Reserve University enables up to four Case Western Reserve students to spend a semester as visiting students at Fisk each year. Up to four Fisk students may spend a semester at Case Western Reserve each year. Fisk University was founded in 1866 as the first integrated coeducational school in the United States, and, at its founding, focused on providing a quality liberal arts education to the children of former slaves. Fisk University has a distinguished history as a liberal arts institution. It was the first historically black college to have chapters of the Phi Beta Kappa and Mortar Board national honorary societies.

Case Western Reserve students who participate in the Case Western Reserve-Fisk Exchange pay tuition to Case Western Reserve University, pay the Fisk room and board fees, and maintain their CWRU student status during the period of the exchange. Information about the exchange program is available from the Fisk exchange advisor in the Office of Undergraduate Studies.

**The Dual Degree (3-2) Program in Engineering**

Students of superior scholarship who have attended one of a group of select liberal arts colleges with which Case Western Reserve University has a dual degree agreement are eligible to participate in the Dual Degree (3-2) (http://engineering.case.edu/delpp/dualdegree) program at Case Western Reserve University. This program allows outstanding students to begin their studies at a liberal arts college for three years and pursue an engineering degree at Case Western Reserve University for two years. Once requirements at both institutions are completed, students will receive a degree from the liberal arts college and a degree from Case Western Reserve University in a designated engineering discipline. For additional information, contact Debbie Fatica (dfx3@case.edu), 304 Nord Hall, 216.368.4449.

**Cleveland Humanities Collaborative**

The Cleveland Humanities Collaborative (http://chc.case.edu) is a partnership between Cuyahoga Community College (Tri-C) and Case Western Reserve University charged with promoting student transfer from Tri-C to CWRU to pursue a liberal arts education through a Bachelor of Arts degree in the humanities. In addition, the program encourages and supports strengthened ties among faculty through programming and academic collaborations. The Collaborative also seeks to enrich the cultural life of northeastern Ohio through quality public programming that supports the appreciation of the humanities and its importance in nurturing engaged citizens and building strong communities.

As students pursue their associate's degree at Tri-C, they are able to explore many of the humanities disciplines available as majors and minors at CWRU. They are also able to take advantage of the longstanding cross-registration program that enables Tri-C students to take two class per semester at CWRU while paying home tuition. Once they are on track to earn their associate's degree, students apply to CWRU as transfer students. Upon acceptance, students become CHC Scholars and participate in a summer bridge program that prepares them for a successful transition to CWRU. At CWRU, CHC Scholars are integrated into humanities programs and are connected to University Circle institutions.

For additional information, contact Abigail Dohanos (CHC@tri-c.edu), Director of the Tri-C Transfer Connection Center, or Allison Morgan (allison.morgan@case.edu), CHC Program Manager.

**Cleveland STEM Pipeline Program**

The Cleveland STEM (science, technology, engineering, and mathematics) Pipeline Program enables students at Cuyahoga Community College (Tri-C) to complete a four-year bachelor's degree in a STEM discipline at Case Western Reserve University as part of CWRU's commitment to advancing STEM education and educational outcomes for students in our local community and to establishing ties among STEM faculty members at Tri-C and CWRU.

As students pursue their associate’s degree at Tri-C, they may enroll in up to eight classes at CWRU while paying home tuition under the longstanding cross-registration agreement between the two institutions. This arrangement gives students participating in the program a head-start on their bachelor's degree and allows them to acclimate to CWRU before they formally enter as degree-seeking students. Once they are on track to earn their associate’s degree, students apply to CWRU as transfer students.

For additional information, contact Donald Feke (donald.feke@case.edu), CWRU Vice Provost for Undergraduate Education.

**Undergraduate Academic Advising**

Academic advising is an important component of the educational program at Case Western Reserve University. Academic advisors assist students in the exploration of academic opportunities at the university and in the selection of courses. Advisors may refer students to other sources of information and assistance at Case Western Reserve.

The advising model at Case Western Reserve aims to balance generalist and field-specific advising, shifting the balance as students progress through their undergraduate careers. At the beginning, a student’s First Seminar instructor provides generalist advising until the student declares a major. At the same time, representatives from each major and minor are available to provide field-specific advice as a student decides on an area of focus. Once a student declares a major, the emphasis shifts to major-focused advising with an advisor assigned in that field to guide the student in the construction of an academic plan and to monitor the student’s progress in pursuit of that plan. Throughout a student’s undergraduate career, the deans in the Office of Undergraduate Studies are available for generalist advising to address concerns that fall outside of the pursuit of a specific major.

Students are expected to initiate and maintain regular contact with their advisors to address the student’s curricular and career concerns, and to review progress towards graduation. At a minimum, students are expected to meet with advisors when declaring a major or minor, before registering for classes each semester, and when making corrections to their academic requirements reports.

**Advising during the First Year**

During a student’s first year at Case Western Reserve, the faculty member instructing the student’s SAGES First Seminar serves as the student’s academic advisor. Students and their advisors are expected to explore the student’s academic interests and concerns, as well as educational and career goals, and to seek expert information and advice about academic policies and procedures and about specific academic programs from the General Bulletin, from newsletters and websites, from the academic representatives in the majors and minors...
designated as first year resources, and from other sources of advice and counseling on campus. Staff in the Office of Undergraduate Studies (http://case.edu/ugstudies) (including the Directors of the First-Year Residential Colleges), the University Career Center (http://studentaffairs.case.edu/careers), Educational Services for Students (http://studentaffairs.case.edu/education), the Office of Multicultural Affairs (http://studentaffairs.case.edu/multicultural), the University Health & Counseling Services (http://studentaffairs.case.edu/counseling), and specialized programs such as Co-op (http://engineering.case.edu/coop) (co-operative education), SOURCE (http://www.cwru.edu/source) (research and creative projects), the Center for International Affairs (http://case.edu/international) (study abroad, international student services), and the Center for Civic Engagement and Learning (http://studentaffairs.case.edu/civicengagement) (community service) are available to support first-year students and their advisors with publications, workshops, websites, experiential learning opportunities, and individual communications.

**Advising in the Majors and Minors**

When a student selects a specific major or minor, the academic representative of that major or minor assigns a faculty advisor. Although some first-year undergraduates enter with definite goals, they are not assigned to advisors in the majors until they have declared their major. First-year students who are ready to declare a major in their first year may do so beginning in November. Students engaging in further exploration of majors are expected to declare a major no later than the end of the second year (See Declaring a Major in the section on Academic Policies and Procedures (p. 1087)). Opportunities for exploration of majors and minors include a Choices Fair, departmental information sessions, and individual conversations with faculty and academic advisors.

After the first year, students who have not declared a major should consult their assigned advisor (noted in their online student information) or the academic representative of an academic department of interest for advice and schedule approval.

**Advising in the Office of Undergraduate Studies**

The Office of Undergraduate Studies serves as a hub for all academic information related to undergraduate enrollment and degree programs. The Associate Dean for First-Year Students and the Directors of the First-Year Residential Colleges work with first-year students. All new transfer students work with a specially assigned dean during their first semester of enrollment at Case Western Reserve; this dean also works with non-degree students. The Associate Dean for First-Year Students and the Directors of the First-Year Residential Colleges work with first-year students. All new transfer students work with a specially assigned dean during their first semester of enrollment at Case Western Reserve; this dean also works with non-degree students. After the first year for students who matriculate as first-year students and after the first semester for students who matriculate as transfer students, each Case Western Reserve student is assigned to an upperclass dean based on the student’s last name. This allows a dean to establish a multi-year relationship with the student, starting in the student’s second year and continuing through the completion of degree requirements.

The deans and advisors in the Office of Undergraduate Studies are available to answer student and faculty questions about University rules, practices, programs, and resources and to meet with students who are interested in accelerated undergraduate to graduate and professional school programs, academic awards, and fellowship and scholarship opportunities. All students who have not declared a major should consult with their first year advisor or with one of the deans in the Office of Undergraduate Studies for advising and schedule approval. Students with interests in health professions and/or law school are encouraged to seek advice from the pre-medical advisor and/or the pre-law advisor in the Office of Undergraduate Studies.

**Undergraduate Grades**

Undergraduate grades at Case Western Reserve University are issued on the following scale, with good standing based on criteria presented in the section on Academic Standing Regulations (p. 1092) and with the requirement of a 2.000 average for graduation. Academic averages are computed by dividing the number of quality points earned by the number of credit-hours completed, excluding transfer credit, credit based on examinations (AP, IB, proficiency, etc.), and courses graded P/NP.

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<thead>
<tr>
<th>Letter Grade</th>
<th>Meaning</th>
<th>Quality Points</th>
<th>Notes</th>
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<tr>
<td>A</td>
<td>Excellent</td>
<td>4</td>
<td></td>
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<tr>
<td>B</td>
<td>Good</td>
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<td>C</td>
<td>Fair</td>
<td>2</td>
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<td>D</td>
<td>Passing</td>
<td>1</td>
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<tr>
<td>F</td>
<td>Failure</td>
<td>0</td>
<td>This grade will be given for academic failure as well as failure to attend class without formally withdrawing</td>
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<tr>
<td>I</td>
<td>Incomplete</td>
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<tr>
<td>W</td>
<td>Withdrawal for a class</td>
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<tr>
<td>WD</td>
<td>Withdrawal from all classes during a given semester</td>
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<tr>
<td>P</td>
<td>Passing in a Pass/No Pass Course</td>
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<tr>
<td>NP</td>
<td>Not Passing in a Pass/No Pass Course</td>
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<tr>
<td>R</td>
<td>For courses which extend over more than one semester</td>
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<tr>
<td>AD</td>
<td>Audit</td>
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**Grade of Incomplete Assignment of the Incomplete Grade:**

The Incomplete grade (I) is assigned by and at the discretion of the instructor when a) there are extenuating circumstances, explained to the instructor before the assignment of the grade, which clearly justify an extension of time beyond the requirements established for and met by other students in the class, and b) the student has been passing the course and only a small segment of the course, such as a term paper, remains to be completed. It is the student’s responsibility to notify the instructor of the circumstances preventing completion of all assigned work. In the absence of notification or adequate justification, the instructor has the authority to assign the student a final grade that assumes a failing grade for the missing work. An Incomplete grade should not be assigned a) when a student has been absent for much of the semester and/or has done little of the work required for a course, or b) because a student is absent from a final examination, unless the dean of undergraduate studies has authorized the grade.

The amount of additional time allowed the student to make up incomplete work should serve to accommodate the student while being
fair to other students in the course. It should be proportional to the duration of a student’s illness or absence and might be no more than a few days or weeks. At the extreme, it should not extend past the eleventh week of the session following the one in which the incomplete grade was received. In certain cases (such as students on probation) the dean of undergraduate studies may establish an earlier date for completion of courses with incomplete grades.

### Changing the Incomplete Grade:

When the student has completed the required work, the instructor shall enter in the Student Information System a final evaluative grade to replace the Incomplete. When a student fails to submit the work required for removing the Incomplete by the date established, the instructor shall enter a final grade that assumes a failing performance for the missing work. In the absence of the assignment of a grade by the instructor, the Registrar will convert the I to F when the deadline for making up Incomplete grades from a previous semester has passed.

### Audit

See section on Academic Policies and Procedures (p. 1087).

### Pass/No Pass

Undergraduate students (degree candidates and non-degree students enrolled at the undergraduate level), other than students participating in the Pre-College Scholars program, may elect to take one course each fall and spring semester on a Pass/No Pass grading basis, provided they remain enrolled in at least 3 credit-hours of courses for regular evaluative grades. Enrollment in courses that are graded on a Pass/No Pass basis (e.g., PHED 55A Cardio-Fitness (First Half)) does not preclude a student’s use of the Pass/No Pass option in another courses taken the same term. The Pass/No Pass option is not available during the summer session or to undergraduate degree candidates enrolled at the graduate or professional levels through the IGS program or Senior Year in Professional Studies.

Instructors are not notified of a student’s use of this option. Instructors submit evaluative grades for all students, and these grades are converted to Pass or No Pass in the Registrar’s Office. Courses elected on a Pass/No Pass basis and completed with a grade of D or higher will be entered with the grade P on the student’s transcript. Courses taken Pass/No Pass for which a grade of F is earned will have NP entered on the transcript. Students who earn a P grade will earn credit for the course, while those who earn NP will not. Grades of P and NP are not included in computing the grade point average.

Students may submit an on-line Pass/No Pass Option form at any time in the fall or spring semester after the end of the drop/add period and before 11:59 p.m. on the day of the course withdrawal deadline for that semester (currently the last day of classes for first-year students and the 11th Friday of the semester for all other students, including new transfer students).

Use of the Pass/No Pass option is subject to the following restrictions:

1. All courses to be counted toward major, minor, or SAGES/general education/core requirements must be taken for regular evaluative grades. If a student opts for Pass/No Pass in a course, that course will not be counted toward any of these requirements.
2. Students majoring in any Weatherhead School of Management degree program (accounting or management) may not use the Pass/No Pass option for any Weatherhead School of Management courses (ACCT, BAFI, BLAW, ENTP, LHRP, MGMT, MIDS, MKMR, OPMT, ORBH, OPRE, PLCY), either required or elective.

3. A decision to use the Pass/No Pass option is irrevocable unless the student needs that course to complete requirements for a major or minor declared in a subsequent semester. In that event, the student may request that the Office of Undergraduate Studies reveal the grade on the transcript at the start of the student’s final term at Case Western Reserve University.

### Grade Changes

Instructors should review grades before submitting them to be confident that they are accurate and fair. If a student requests a change of grade or reevaluation of work once final grades have been reported, the instructor should review his or her grading for possible mistakes. However, in fairness to the whole class, the instructor should then review the work of all students whose grades may be questionable, not just those who come to the instructor with concerns. Similarly, if students who have earned a low grade ask to perform additional work for extra credit in hope of raising their grades, and the instructor agrees, that same opportunity should be offered to all students whose grades are below an A. Most courses are planned for completion within the semester; instructors should avoid extending coursework beyond the semester’s limits without good reason.

Instructors should not change grades for students who indicate that they will lose their scholarships or suffer other consequences from a poor grade. Students have numerous opportunities during the semester to seek assistance in improving their performance or to withdraw from the course.

Changes to undergraduate student grades must be submitted through the Student Information System (https://case.edu/sis). Grade change requests will be forwarded to the department chair for approval and then to the Dean of Undergraduate Studies for review before they are posted.

### Grade Reports and Transcripts

Students may view their grades on the Student Information System (https://case.edu/sis). Students can request official copies of their transcripts (http://www.case.edu/registrar/transcripts.html) from the Registrar’s Office. The University considers the grades earned by a student and other information about the student’s performance at the University confidential and will release such information only upon written request by the student. Transcripts will not be issued to or on behalf of students who have not discharged all obligations to the University.

### Course Repetition

See section on Academic Policies and Procedures (p. 1087).

### Mid-Semester Grades

Mid-semester grades are assigned in undergraduate courses at the end of the eighth week of each semester. Mid-semester grades are advisory; the grades are not part of a student’s official academic record or transcript. At mid-semester, an instructor may assign to undergraduates evaluative letter grades (A, B, C, D, or F) or grades of satisfactory (S) and unsatisfactory (U), with S corresponding to performance in the range of A through C, and U corresponding to performance in the D or F range. (S and U may not be assigned as final course grades in undergraduate courses.) Students may view their mid-semester grades on the Student Information System (https://www.case.edu/sis). Students who have any low or unreported mid-semester grades should discuss their progress with their instructors and with their advisors.
Undergraduate Academic Policies and Procedures

Academic regulations governing undergraduates are administered by the Office of Undergraduate Studies. Academic regulations are subject to change by action of the Faculty Senate, its Committee on Undergraduate Education, and the various committees responsible for the oversight of curriculum and academic standing.

When circumstances so warrant, a student may submit to the Office of Undergraduate Studies a petition requesting an exception to a specific regulation. Petition forms are available in the Office of Undergraduate Studies, 357 Sears Bldg.

Academic Grievance Policy

A student who wants to register a complaint about course instruction or evaluation should first bring the matter to the direct attention of the professor or instructor involved. If the matter is not satisfactorily resolved, the student should go to the chair of the academic department in question and seek departmental review. If neither step resolves the complaint, the student may take the matter to the faculty member’s college or school dean for final review and decision.

Academic Integrity Policy

See section on Academic Integrity Policy (p. 1090).

Academic Standing

See section on Academic Standing Regulations (p. 1092).

Attendance

Students are expected to attend classes regularly. Each instructor is free to determine the extent to which absences affect the final grades of students but should make the policy regarding attendance known at the start of the course. Instructors should report excessive absences to the Office of Undergraduate Studies. Instructors who judge a student’s absences from class to be excessive may drop the student from the course with a grade of F. Instructors taking such action must notify the student’s dean in writing.

Absence due to Illness

Students unable to attend classes because of illness should seek appropriate medical care and collect documentation from their health care provider. In most cases, students will notify their instructors and make the appropriate arrangements directly with the instructor. When needed, the Office of Undergraduate Studies will collect documentation of the illness from the student and report on that documentation to the student’s instructors.

Absence due to Religious Observance

Any student who is unable to attend classes or participate in any examination, study, or work requirement on a particular day because of his or her religious beliefs is excused from any such activity. The student will be given the opportunity to make up the examination or work that is missed, provided the make-up work does not create any unreasonable burden upon the university. When possible, students should give notice to instructors early in the semester about missing classes because of religious observance.

Credit by Examination

Advanced Placement/International Baccalaureate/ French Baccalaureate/A-Level Examinations

Students may earn degree credit on the basis of advanced examinations taken while in secondary school. Examinations eligible for credit and/or advanced placement include, but are not limited to, College Board Advanced Placement Examinations, International Baccalaureate Higher Level Examinations, French Baccalaureate, and A-Levels. Determination of the criteria for granting credit and/or placement is made by the appropriate department.

Proficiency Examinations

Departments within each academic unit offering undergraduate programs may choose to offer students the opportunity to earn course credit in specific courses by proficiency examination. To qualify for proficiency examination credit for a course, the student’s examination performance must demonstrate knowledge and skills at a level no lower than that of an average student who successfully completes the course. Upon notification from the academic department, the Office of Undergraduate Studies will post credit for the course on the transcript. The grade will be recorded as PR, and will not be included in a student’s grade point average.

Declaring a Major or Minor

Students matriculating at Case Western Reserve University as first-year students may begin declaring their majors, though are not required to do so, on November 1 of the fall semester. Transfer students may begin declaring their majors at the start of their first semester at Case Western Reserve. A choice or change of major or minor is not recorded for any
student until the major or minor declaration form, bearing the signature of the student, the name of the advisor, and the signature of the academic representative for the major or minor, has been completed and submitted to the Office of Undergraduate Studies, 357 Sears Bldg.

Students who enroll at Case Western Reserve University as first-year students are expected to declare a major before registering for classes for their fifth semester of enrollment. Transfer students are expected to declare a major before registering for their third semester at Case Western Reserve. Beyond that point, students who have not declared a major will have a registration hold placed on their accounts until they have done so. Those who will have earned fewer than 60 credit-hours (including transfer, AP, IB, and proficiency credit) by the end of the fourth semester for students who started as first-year students, or by the end of their second semester for transfer students, may request that their dean in Undergraduate Studies allow them to register for the next semester by lifting the registration hold. Students may later change their majors should their academic interests change.

Enrollment and Registration

For continuing students, registration for the fall semester begins in April, and registration for the spring semester begins in November. Complete registration instructions and regulations appear on-line on the web site of the University Registrar (http://www.case.edu/registrar).

Course Loads and Overloads

In order to be classified as a full-time student, a student must enroll for a minimum of 12 credit-hours by the end of the drop/add period. Eligibility for many forms of financial aid, participation on intercollegiate varsity sports teams, and maintaining certain visa statuses for international students require full-time status. Students registering for fewer than 12 credit-hours are classified as part-time and charged tuition on the basis of the number of credit-hours being taken.

The normal full-time load is 14-17 credit-hours. Students ordinarily may not enroll in more than 19 credit-hours in a semester. Any schedule of more than 19 credit-hours requires a dean's approval. Continuing students may enroll for 20-21 hours in a semester if they have a cumulative grade point average of 3.200 or better. To register for 22 or 23 hours, a minimum grade point average of 3.500 is required. Graduating seniors may be approved for overloads within reason if they need such a schedule in order to graduate at the end of the semester in question.

Course Placement

No credit will be allowed to count towards degree requirements for foreign language or mathematics courses which duplicate work taken earlier in high school or in another institution. First-year undergraduates who have questions regarding their eligibility to receive credit for foreign language or mathematics courses should see the associate dean for first-year students in the Office of Undergraduate Studies.

Course Repetition

Students have the opportunity to repeat a course in order to improve their mastery of the course material. When a course is repeated, the student will earn credit for the course only once, but both the original grade and the grade for the repeated course will be included in the semester and cumulative grade point averages, each weighted by the credit-hours for the course. The student's transcript will show the comment "REPEATED: NO CREDIT AWARDED," credit will instead be awarded for the course taken at Case Western Reserve University. However, if the first attempt of the course resulted in a passing grade but the second attempt results in a failing grade, the student will continue to earn credit for the first attempt, but both grades will be included in the semester and cumulative grade point averages.

The course repeat option may not be exercised after a degree has been awarded.

Audit

A student may audit a course with the dean's or advisor's approval and the consent of the instructor of the course. An auditor receives no credit for the course. At the beginning of the course, the student and instructor should reach agreement regarding the requirements to be met for a grade of AD. The grade of AD is entered on the student's transcript if approved by the instructor of the course. If the instructor does not approve the grade AD, the enrollment is not posted on the transcript.

Registration in a course cannot be changed from audit to credit or the reverse after the end of the drop/add period. However, a student may take for credit a course he or she audited in an earlier semester.

Enrollment Changes

Drop/Add

Changes in course schedules must be submitted to the Registrar's Office using the Student Information System or a drop/add form before the end of the second week of classes during the fall and spring semesters. However, for courses that run for half of the semester, students are allowed only a one-week drop/add period at the start of those courses. Deadlines for dynamically-dated courses (i.e. those that meet on some alternative schedule) are set in a proportional manner. Similarly, the drop/add deadline for summer courses are set in a proportional manner, with the deadline ordinarily being the second day of classes.

Students who add a course after the start of the semester are responsible for any work missed and are expected to speak with the instructor to learn the consequences of any work missed and whether there are opportunities for making up missed work. In some cases, the instructor of a course may require his or her consent before a student may add a course during the second week of the drop/add period.

Withdrawal from a Course

The First Undergraduate Year:

For the first two semesters of enrollment, matriculated students who are beginning their college studies may withdraw from a course at any time during the semester, but no later than the last day of classes. Any course for which a grade of W is assigned will be deleted from the transcript at the end of the semester. This policy is not available for transfer students and does not apply to the summer session.

After the First Undergraduate Year:

A student may withdraw from a course no later than the end of the 11th week of the semester and receive a grade of W. In extenuating circumstances, a student may petition for permission to withdraw from a course after the deadline and receive a W. The grade of W will be posted on the student's transcript.

For all course withdrawals:

Students in good academic standing (i.e., not on probation, probation incomplete, or continued on probation) may withdraw from courses through the Student Information System, provided that they remain
actively enrolled in at least 12 credit-hours. All other course withdrawals (those by students who are not in good standing and those that take a student below 12 credit-hours of active enrollments) must be transmitted by the student to the Registrar’s Office on the appropriate form, signed by a dean in the Office of Undergraduate Studies. Failure to attend class or providing notice only to the instructor does not constitute an official withdrawal from a course. Such an unofficial withdrawal normally will result in the student's being assigned the grade of F.

Students are ordinarily not permitted to withdraw from a course after a grade has been posted.

Withdrawal from the University
To withdraw from the university during a semester or session, a student must complete an official withdrawal form in the Office of Undergraduate Studies or the on-line form in the Student Information System (SIS) by the last day of classes for that semester or session. Grades of WD will be assigned in all courses in which a student is registered at the time of withdrawal, provided that the student follows the procedures stated above. Failure to attend classes or notification of instructors only does not constitute withdrawal from the university. A student who ceases to attend or otherwise participate in courses without officially withdrawing will be assigned the grade F for each course in which he or she is enrolled.

If the withdrawal is necessary for reasons of health, a statement from the student’s physician to the University Health Service may be required as a condition of re-enrollment.

Students who withdraw from the university after the end of the 11th week of the semester may not enroll for the next two academic sessions, including the summer session. Exceptions may be granted by the Academic Standing Board.

Students who complete a semester but do not plan to return for the following semester must similarly complete an official withdrawal form in the Office of Undergraduate Studies or the on-line form in the Student Information System (SIS).

Final Examinations and Reading Days
Final Examinations
Final examinations normally are required in all courses and must be given during the final examination period at the time assigned by the Registrar; they may not be given during the final week of classes or on Reading Days. Any exception must be approved by the dean of undergraduate studies.

No student will be required to take more than two final examinations on a single calendar day, nor will a student be required to take a final exam in the evening exam period (7:30-10:30 PM) and another final exam in the morning exam period the next day (8:00-11:00 AM). A student who has two final exams at the same time, more than two final examinations scheduled for the same day, or a morning exam following an evening exam will be contacted by the Office of Undergraduate Studies after the course withdrawal deadline for upperclass students about alternative arrangements; the student should contact the Office of Undergraduate Studies to obtain the assistance of the dean if the student does not receive notification within a week of the course withdrawal deadline for upperclass students.

A student must explain immediately and in writing to the dean of undergraduate studies an absence from a final examination. If the explanation is acceptable, the dean will authorize the assignment of the gradeIncomplete and the administration of a make-up examination by the instructor. In the event of an unexcused absence from a final examination, the instructor should assign the student a final grade that assumes a grade of zero on the final examination and is consistent with the grading policy established for the course.

Reading Days
Prior to and/or during the final examination period two weekdays are set aside as Reading Days to be used by students for completing assignments and preparing for final examinations. In the fall semester there will be one reading day on Monday of the first exam week and one reading day on Friday of the first exam week. In the spring semester, the two days prior to the beginning of the final exam period are set aside as reading days. These days are not to be used by faculty for scheduling examinations or other course activities that require the attendance of students. They may be used by faculty to schedule review sessions for which attendance is optional.

Graduation and Commencement
Application for Graduation
A student who has completed all graduation requirements in fewer than four years has the choice of graduating early or deferring graduation in order to graduate with his or her class. A student who completes all graduation requirements in four years or more must graduate at that time. The student must file an on-line application for the degree through the Student Information System by October 1 for January graduation, by February 1 for May graduation, and by June 1 for August graduation.

A student must discharge all financial obligations to Case Western Reserve University to receive a diploma and for the Registrar’s Office to release final transcripts.

Graduation Check
Students must ensure that their Academic Requirement reports reflect accurately their progress toward their degrees. All requested corrections and exceptions must be submitted to the Office of Undergraduate Studies at least one semester prior to graduation. Academic Requirement reports are available on-line through the Student Information System.

Participation in Commencement
Students are eligible to participate in May commencement activities if they have completed all degree requirements during that spring semester or the immediately preceding fall semester or summer session, or if they have an appropriate plan to complete their degree requirements in the upcoming summer session or fall semester. A student may participate in Commencement only once as a bachelor’s degree candidate, though exceptions are sometimes made for students receiving a second bachelor’s degree at least one year after the first.

Incompletes
See section on Grades.

Pass/No Pass
See section on Grades.

Promotion
The standards for promotion are:

- To the sophomore class, 27 credit-hours completed
• To the junior class, 60 credit-hours completed
• To the senior class, 90 credit-hours completed

Readmission After Separation
See section on Academic Standing (p. 1092).

Re-Enrollment After Voluntary Withdrawal
Students who have voluntarily withdrawn from the university and have not taken courses elsewhere following their withdrawal may petition to re-enroll in any semester. If the withdrawal was necessary for reasons of health, a statement from the student’s physician to the University Health Service may be required as a condition of re-enrollment. Students who have taken courses elsewhere following withdrawal must provide official transcripts of their work with their request for re-enrollment.

Upon re-enrollment following a voluntary withdrawal, students retain the credit-hours earned and quality points for courses completed prior to withdrawal. In the first semester of re-enrollment, their academic status is the status in effect at the time of withdrawal, unless that status is changed by action of the Academic Standing Board.

Scholarship Retention
See section on Criteria for Scholarship Retention (p. 1093).

Student Access to Records
The academic records of all students are kept in the Office of Undergraduate Studies, 357 Sears Building. Students may review their files in that office by appointment. A student must sign a request and present his/her ID card at the time of the appointment.

Study at Other Colleges and Transfer Credit
Students may receive transfer credit for work completed at another accredited college, university, or technological institute in the United States or from institutions of higher education outside the United States. Credit is not awarded for work done at an unaccredited institution in the United States except by proficiency examination in those departments of Case Western Reserve University offering that opportunity.

At the time of admission to Case Western Reserve University and upon presentation of an official transcript from each institution previously attended, credit will be awarded for courses equivalent or comparable to those offered by the University and completed with a grade of C or better. Any such courses taken prior to the student's graduation from high school must be listed in the college's catalog among courses offered for degree credit to the college’s undergraduates, taken in the company of matriculated college students, and organized and taught by college faculty. In addition, to be considered for transfer credit, such courses must not have been used to fulfill high school graduation requirements. The awarding of transfer credit is determined by the Office of Undergraduate Studies in consultation with the appropriate department.

After matriculation at Case Western Reserve University, students are permitted to earn at other accredited colleges or universities or through an approved program of study abroad no more than 38 credit-hours toward the totals required for the degree, including courses taken through the cross-registration program, with no more than 15 credit-hours taken as part of domestic programs or as summer study in a student’s home country; any off-campus study credits beyond 15 may only be taken through approved programs of study abroad. Any additional credit earned at other institutions after matriculation at Case Western Reserve beyond 15 domestically or as summer study in a student's home country and beyond a total of 38 including study abroad will raise the total number of credit-hours required for the degree by a corresponding number.

Permission of a dean in the Office of Undergraduate Studies must be obtained in advance if the student wishes to enroll elsewhere. The awarding of transfer credit is determined by the Office of Undergraduate Studies in consultation with the appropriate department. Further, if a student wishes to take elsewhere a course to satisfy a major or minor requirement, it must also be approved by the department chair or academic representative. Upon presentation of an official transcript from each institution attended, transfer credit will be awarded for courses equivalent or comparable to those offered by Case Western Reserve University and completed with a grade of C or better. Credit earned elsewhere after matriculation at Case Western Reserve University is not applied toward the residence requirement of a minimum of 60 credit-hours earned at Case Western Reserve, including at least 15 after a student has earned a total of 105 credit-hours. The Off-Campus Study Request Form is available on the Undergraduate Studies web site (http://case.edu/ugstudies).

A student separated for poor scholarship may not earn transfer credit for courses taken in the first two sessions after that dismissal.

Grades for courses taken at other institutions will not be entered on the student’s record nor will they be computed in the student’s grade point average.

In addition to the regulations concerning transfer credit outlined above, the following special restrictions apply to credit for summer courses taken at other colleges, universities, or technical institutes:

1. Students ordinarily will not be permitted to take elsewhere in Cuyahoga County courses offered at Case Western Reserve University. Exceptions to this policy will be permitted only in the event of significant extenuating circumstances. Students who desire the opportunity to take elsewhere in Cuyahoga County a course being offered at Case Western Reserve must petition the Office of Undergraduate Studies in advance for permission to do so.

2. Students must be in good standing. If a student is placed on probation between receiving permission and the start of off-campus enrollment, the student is no longer eligible to enroll for and receive transfer credit for this work. Students on probation require special approval and should contact a dean in the Office of Undergraduate Studies.

3. Students may register for no more than 12 credit-hours. One quarter-hour equals two-thirds of one credit-hour at CWRU.

4. Students may transfer credit only for courses in which a semester's work is completed in a minimum of three weeks.

Academic Integrity
Students, faculty, and administrators share responsibility for the determination and preservation of standards of academic integrity. Not only must they adhere to their own personal codes of integrity but they must also be prepared to educate others about the importance of academic integrity, to take reasonable precaution to discourage violations of academic integrity, and to adjudicate violations.
For students, education about the importance of academic integrity begins during the admissions process. The centrality of integrity to the academic enterprise is reinforced during new student orientation when students engage in discussion about academic integrity. Specific mention of academic integrity and course-specific guidelines should be presented in all classes. Programs and instruction about academic integrity guidelines also should be offered throughout the students’ undergraduate career.

Faculty and students are expected to uphold standards of academic integrity by taking reasonable precaution in the academic arena. Reasonable precaution involves implementing measures that reduce the opportunities for academic misconduct but do not inhibit inquiry, create disruption or distraction in the testing environment, or create an atmosphere of mistrust.

The vitality of academic integrity is dependent upon the willingness of community members to confront instances of suspected wrongdoing. The faculty have a specific responsibility to address suspected or reported violations as indicated below. All other members of the academic community are expected to report directly and confidentially their suspicion of violation to a faculty member or a dean or to approach suspected violators and to remind them of their obligation to uphold standards of academic integrity.

Definition of Violations

All forms of academic dishonesty including cheating, plagiarism, misrepresentation, and obstruction are violations of academic integrity standards.

• Cheating includes copying from another’s work, falsifying problem solutions or laboratory reports, or using unauthorized sources, notes or computer programs.

• Plagiarism includes the presentation, without proper attribution, of another’s words or ideas from printed or electronic sources. It is also plagiarism to submit, without the instructor’s consent, an assignment in one class previously submitted in another.

• Misrepresentation includes forgery of official academic documents, the presentation of altered or falsified documents or testimony to a university office or official, taking an exam for another student, or lying about personal circumstances to postpone tests or assignments.

• Obstruction occurs when a student engages in unreasonable conduct that interferes with another’s ability to conduct scholarly activity. Destroying a student’s computer file, stealing a student’s notebook, and stealing a book on reserve in the library are examples of obstruction.

Discussing, Reporting and Adjudicating Violations

If a faculty member suspects that an undergraduate student has violated academic integrity standards, the faculty member shall advise the student and the department chair and consult with the Dean of Undergraduate Studies about the appropriate course of action. Before speaking with the student, the faculty member also may choose to consult with the chair or dean about academic integrity standards. If the faculty member, in consultation with the dean, determines that the evidence is not adequate to charge the student with a violation, the matter will be dropped. Otherwise, the following procedures will be followed.

First Violations

If the faculty member and the student agree that a violation has occurred, and the violation is determined to be a first violation (the university has no record of previous academic integrity violations by the student), the faculty member shall choose either to sanction the student or to refer the case to the academic integrity board. If the faculty member chooses to sanction the student, the minimum sanction is failure in the work in question and the maximum sanction is failure in the course. The faculty member will be provided with a standard reporting form to be signed by both the student and faculty member.

However, the case will be referred to the Office of Student Conduct and Community Standards for Academic Integrity Board action if:

1. the student claims not to have violated academic integrity standards or the student disagrees with the sanction imposed by the professor (provided that the sanction is greater than the minimum); or

2. the faculty member feels that the seriousness of the first offense warrants presentation to the Academic Integrity Board or the faculty member, after consultation with the dean, prefers to have the Academic Integrity Board investigate or adjudicate the alleged violation, or prefers that the Board sanction the student.

The signed report form from a faculty member or the finding of responsibility by the Academic Integrity Board will become part of the student’s university judicial file. Students found responsible for a first violation will be required, in addition to any other sanctions imposed, to attend an ethics education program or to complete an ethics exercise as assigned by the Dean of Undergraduate Studies or the Director of the Office of Student Conduct and Community Standards or their designees.

Subsequent Violations

If the university judicial file indicates that the student suspected of a violation has been responsible for one or more previous violations of the university’s Academic Integrity Policy, the case will be referred to the Office of Student Conduct and Community Standards for Academic Integrity Board action.

Misrepresentation and Obstruction

Reports of suspected academic misrepresentation or obstruction occurring in settings other than the classroom will be referred to the Office of Student Conduct and Community Standards for Academic Integrity Board action.

Academic Integrity Board

If a suspected or known violation of academic integrity standards warrants consideration by the Academic Integrity Board, the Director of the Office of Student Conduct and Community Standards will convene the Board. The Board will be composed of three students (voting members) appointed by the Undergraduate Student Government, two faculty (voting members) appointed from a list of faculty members annually identified by the Office of Undergraduate Studies and the Office of Student Affairs as willing to serve and approved by the Executive Committee of the Faculty Senate, and two administrators (non-voting members). One administrator will be a dean from the Office of Undergraduate Studies. The other administrator will be a representative of the Office of Student Affairs and will chair the Board. All members of the Board may question witnesses. Academic Integrity Board procedure, the vote required for the determination of responsibility, and the evidence standard will be the same as those for the University Judicial Board.
Academic Standing Regulations

Should the Board find the student not responsible for a suspected violation, the faculty member and the student will be so informed. The faculty member will be asked to evaluate the student's performance in the assignment in question and to issue a grade based on his or her normal grading practices.

If the Board finds a student responsible for a violation of academic integrity standards, the Board will notify the student and the faculty member. The Board can sanction violations by issuing failure in the work in question, failure in the course, university disciplinary warning, university disciplinary probation, university disciplinary suspension, or expulsion.

In cases in which the Academic Integrity Board finds a student responsible for a second or subsequent violation, the minimum sanction will be failure in the course; the maximum penalty will be expulsion.

If the Academic Integrity Board finds a student responsible for misrepresentation or obstruction, the minimum sanction will be university disciplinary probation; the maximum penalty will be expulsion.

Violations Reported After Voluntary Withdrawal or Academic Separation

Suspected violations of academic integrity standards reported after a student voluntarily withdraws or is academically separated will be investigated and adjudicated. A student who withdraws or is academically separated during the investigation and adjudication of a suspected violation may be asked to appear at a hearing or, if the student fails to appear, have his or her case heard in absentia. If the student is found responsible for a violation, sanctions can be imposed.

Violations Reported After Graduation

In the event that a suspected violation of academic integrity standards is reported after graduation, the Director of the Office of Student Conduct and Community Standards or his/her designee will make a determination as to the feasibility of investigation and adjudication. Graduation will not preempt investigation or adjudication of a suspected violation when those processes are feasible. If a student is found responsible for a violation and the sanction imposed makes the student ineligible to earn his or her degree, the degree may be revoked.

Maintenance of Records

Violations of academic integrity standards are considered violations of the university’s Standards of Conduct and will be recorded in the student’s judicial record. University judicial files are maintained by the Office of Student Conduct and Community Standards in the Division of Student Affairs.

Academic Standing Regulations

The Academic Standing Board monitors the progress of all undergraduate degree candidates at the end of each fall and spring semester to ensure that they are making appropriate progress toward earning their degrees in terms of the grades and number of credit-hours earned each semester. All degree candidates begin their academic careers in good standing. Those who fail to meet the requirements to continue in good standing, as defined below, are automatically placed on academic probation for the following semester in order to signal the need to improve their academic performance. Those who fail to meet a minimum set of academic standards defined below or who do not return to good standing after a semester of academic probation are ordinarily separated from the university for a period of two academic sessions, including the summer session.

Good Academic Standing

Full-time First-Year and Transfer Students in the First Semester

In order to maintain good academic standing at the end of the first semester at Case Western Reserve University, a full-time (i.e., enrolled in at least 12 credit-hours at the end of the drop/add period) first-year student or new transfer student must:

1. earn a semester grade point average of 2.000 or higher AND
2. earn a minimum of 9 credit-hours in that semester.

Full-time Students After the First Semester

Following the first semester of the first year, full-time students (i.e., those enrolled in at least 12 credit-hours at the end of the drop/add period) will be in good standing provided they:

1. earn a semester grade point average of 2.000 or higher AND
2. earn a minimum of 12 credit-hours in that semester.

Part-time Students

Part-time students (i.e., those enrolled in fewer than 12 credit-hours at the end of the drop/add period) will be in good standing if they earn a semester grade point average of 2.000 or higher.

NOTE: Any student with incomplete grades at the end of a semester may be placed on "probation (incomplete)" or made "ineligible to register," as described below.

Academic Probation

Students who, at the end of any semester, fail to maintain the standard of performance required for good standing as specified above will be automatically placed on probation. In order to continue for the next semester, students on probation are required to review their course schedules with their deans in the Office of Undergraduate Studies before the end of the drop/add period. While on probation, students are ineligible to represent the university in intercollegiate activities and may not hold an elective or appointed office or chair a committee in any campus organization. In addition, they may not earn degree credit for work completed at another college or university during the period of probation without special permission.

When placed on academic probation, students will be expected to perform at a level that will return them to good standing at the end of the next semester. If they fail to return to good standing at the end of the following semester, they will be considered for separation from the university for at least two academic sessions, including the summer session.

A full-time student placed on probation who subsequently enrolls as a part-time student will not be reviewed for further academic action until he or she has completed sufficient semesters to total at least 12 credit-hours. At that time, the student will be reviewed on the basis of a composite of those semesters.

Similarly, a student who goes on probation as a part-time student will not be reviewed for further academic action until he or she has completed sufficient semesters to total at least the number of credit-hours attempted in the semester for which the student was placed on
probation. At that time, the student will be reviewed on the basis of a composite of those semesters and will be expected to have earned at least the number of credit-hours attempted in the semester for which he or she was placed on probation.

Academic probation is part of a student’s record at Case Western Reserve University recorded on the internal unofficial/advising transcript, but beginning in Fall 2017, is not recorded on the official transcript.

**Probation (Incomplete):**
A student's status will be Probation (Incomplete) if he or she has Incomplete grades which would result in the student's being placed on academic probation if those Incomplete grades were converted to F's. Once the Incompletes are converted to final grades, the student shall be restored to good standing or placed on academic probation as determined by the semester grade point average and the number of credit-hours earned. In order to continue for the next semester, a student whose status remains Probation (Incomplete) is required to review their course schedule with their dean in the Office of Undergraduate Studies before the end of the drop/add period.

**Separation**
Students on academic probation who fail to return to good standing at the end of the following semester will be considered for separation from the university for at least two academic sessions, including the summer session.

Also, full-time students at the end of their first semester at Case Western Reserve University will be considered for separation without a semester of probation if they:

1. earn a semester grade point average less than 1.000 AND
2. earn fewer than 9 credit-hours in that semester.

After the first semester, full-time students will be considered for separation without a semester of probation if they:

1. earn a semester grade point average less than 1.000 OR
2. earn fewer than 9 credit-hours in that semester.

Part-time students are not considered for separation without already being on probation, but will be reviewed for separation if they fail to return to good standing after a period of probation.

While separation is the ordinary response to academic records of the kind just described, it is not an automatic process. Students being considered for separation will be asked to prepare a statement explaining the difficulties that interfered with their ability to earn a satisfactory record. This is the student's opportunity to appeal separation. If a student thinks he or she should not be separated, the statement should include an explanation of why the Academic Standing Board should have confidence in the student's ability to return to good standing at the end of the next semester and should outline the plan the student has established for ensuring academic success. The Academic Standing Board will decide to separate the student or to place or continue the student on academic probation based on a review of the student's statement and the academic record. In order to continue for the upcoming semester, students placed or continued on probation are required to review their course schedules with their deans in the Office of Undergraduate Studies before the end of the drop/add period.

Academic separations are recorded on both the unofficial/advising transcript and the official university transcript.

Students separated for reasons of academic performance may not earn transfer credit for work completed elsewhere.

**Readmission from Separation**
Students who have been separated because of poor academic performance may petition for readmission after two academic sessions, including the summer session, have elapsed. Students readmitted after being separated for reasons of academic performance will retain all credits and quality points earned before separation, and the cumulative grade point average will be continued, including all grades earned before and after separation.

**Permanent Separation**
A second academic separation following review by the Academic Standing Board will ordinarily be permanent.

**Ineligible to Register**
Students will be declared "ineligible to register" when they have Incomplete grades which would result in the student's being considered for separation if those Incomplete grades were converted to F's. These students will be required to finish the incomplete courses with grades that justify their retention before they will be allowed to continue for the next academic session, unless they successfully petition the Academic Standing Board for permission to enroll.

**Summer Enrollment at Case Western Reserve University**
Students will not be reviewed for academic action at the end of the summer session except in the following two situations:

1. A student on academic probation as of the end of the spring semester will be returned to good standing at the end of the summer session if he or she has completed at least 6 credit-hours at Case Western Reserve University with a summer grade point average of at least 2.000.
2. Nursing students who enroll during the summer session for a full course-load (at least 12 credit-hours) that includes the capstone course will be reviewed according to the standards of a regular fall or spring semester.

**Undergraduate Criteria for Scholarship Retention**
Students who are awarded Case Western Reserve University scholarships based on academic achievement or potential are expected to perform at an appropriate academic level and maintain good conduct in the community. These scholarships will be automatically renewed each semester, provided that the student meets the retention criteria established for his or her scholarship at the time of initial award.

**Full-Tuition (Andrew Squire, Albert W. Smith, Alexander Treuhaft, and Dance, Music, and Theater Performing Arts), University, Michelson-Morley STEM, and Bolton Scholarships**
The academic records of scholarship recipients are ordinarily reviewed at the end of each semester. To have a scholarship renewed for
the following semester, the student must be in good academic and disciplinary standing.

In exceptional cases, the Academic Standing Board will continue a scholarship for a student whose achievement or whose attendance does not meet the standards outlined above. It is the student’s responsibility to write to the Academic Standing Board, c/o the Office of Undergraduate Studies, within 7 business days of the end of the exam period each semester to request special consideration for continuation of a scholarship. This appeal should inform the committee of any special circumstances which may have affected performance and/or attendance during the preceding academic semester, provide any relevant documentation, and describe a plan for how academic performance will be improved in the future.

Students who lose their scholarships because of unsatisfactory academic or disciplinary standing will have their scholarships automatically reinstated at the start of the next semester if they return to good standing. These students lose a semester of scholarship eligibility for each semester that they fail to achieve good standing; that is, students will not receive these scholarships while on probation or during their first semester back from an academic separation, and the maximum number of semesters for which they can receive their scholarships will be reduced. However, students placed on probation at the end of the spring semester who return to good standing based on summer coursework at Case Western Reserve University (see Academic Standing Regulations (p. 1092)) will continue their scholarships for the fall semester without interruption or loss of a semester of eligibility.

Other Scholarships Awarded by Case Western Reserve University

Recipients of scholarships other than those listed above should refer to their scholarship award letters for specific scholarship retention criteria.

Duration

A student who meets the standards for scholarship retention may receive scholarship assistance for no more than eight semesters of full-time undergraduate study (less any semesters lost due to falling out of good academic or disciplinary standing, as described above). The scholarship is awarded for full-time enrollment in regular (fall and spring) semesters.

A scholarship recipient who does a complete withdrawal during a semester will have used up a semester of scholarship eligibility, but will be eligible to receive the scholarship again when he or she next enrolls, provided that his or her leave of absence does not last more than one semester (as described below). If a scholarship recipient completes a bachelor’s degree in fewer than eight semesters of full-time study at Case Western Reserve University, the scholarship will be terminated upon completion of the degree.

In the eighth semester (or in the final semester for a student completing the bachelor’s degree in fewer than eight semesters), a recipient may request permission for part-time enrollment with pro-rated scholarship support if completion of the degree does not require full-time enrollment in that final semester.

Semesters spent participating in the Cooperative Education Program, the Practicum Program, or on a leave of absence are not counted against a student’s eight full-time semesters of scholarship eligibility.

Leave of Absence Policy

A scholarship recipient may take a one-semester leave of absence during the student’s undergraduate career and put the scholarship “on hold” for reactivation upon the student’s return to Case Western Reserve University. Requests for a one-semester leave of absence must be submitted in advance to the Office of Undergraduate Studies. Requests for leaves of absence longer than one semester must be submitted to the Academic Standing Board and will be reviewed on an individual basis.

A scholarship is automatically terminated upon a student’s transfer to another institution or upon permanent separation from the University.

Undergraduate Honors and Awards

Dean’s Honors Lists

The Dean’s Honors Lists consist of the names of those undergraduate students who have distinguished themselves by achieving during the previous semester the grade point averages required with a minimum of 12 credit-hours earned and who have no Fs or NPs, during the same period. Students with a grade point average of 3.750 or higher will be placed on the Dean’s High Honors List. Students with a grade point average of at least 3.500 but less than 3.750 will be placed on the Dean’s Honors List. Students whose records include Incompletes become eligible for the Dean’s Honors Lists once all Incompletes have been converted to final grades. Having earned a place on the Dean’s Honors List or Dean’s High Honors List is noted on the transcript.

Latin Commencement Honors

Latin Commencement Honors are awarded to the top 35 per cent of the graduating class based on overall grade point average.

- Top 10 per cent: summa cum laude
- Next 10 per cent: magna cum laude
- Next 15 per cent: cum laude

The specific GPA cutoffs are determined each year after the awarding of August degrees on the basis of the GPAs of students who graduated over the past five years. These cutoffs are then applied to degrees awarded in the following January, May, and August.

To be eligible for commencement honors, candidates must have:

1. Earned a minimum of 54 credit-hours for evaluative grades (A, B, C, D) in residence at the University.
2. Attained the required percentile ranking on the basis of all work for which grades are averaged at the University, including any grades earned before an academic separation.

Honors in the Major

Some majors offer outstanding students the opportunity to complete an honors program. Students who participate in an honors program in the major and satisfy the requirements for such a distinction, as specified by the major, may qualify to receive the degree “with honors in the major.” The academic representative for the major can provide information regarding requirements for graduation with honors in the major.

Phi Beta Kappa

Phi Beta Kappa, a national honor society, recognizes outstanding scholarship in the arts and sciences. The Alpha Chapter of Ohio, established in Western Reserve College in 1847, was one of the first ten established nationally. Students may qualify for election to membership in the second semester of the senior year. A few outstanding students may be elected to membership as juniors.
Accountancy

To be eligible for academic awards in accounting, students must be upperclassmen with at least a 3.25 grade point average and have completed a minimum of 30 semester hours of accounting courses. The accounting profession and provide leadership for future generations of accountants.

• The Andrew D. Braden Award for Excellence in Auditing and Financial Reporting Studies to a student whose achievement as an undergraduate in auditing and financial reporting subjects is recognized as demonstrating attributes consistent with professionalism and leadership.
• The Apple Growth Partners Scholarship Award to a junior, senior, or Master of Accountancy accounting major with a grade point average of 3.250 or higher and who has displayed high ethics and strong leadership in student organizations.
• The Beta Alpha Psi Award for excellence in accounting.
• The Beta Alpha Psi Leadership Award.
• The Beta Alpha Psi Scholars Recognition Award for outstanding scholarship among members of the Pi Chapter.
• The Cashy Family Scholarship Award.
• The Charles and Barbara Webb Scholarship Award.
• The Dean’s Achievement Award in Accounting.
• The Dean’s Award in Accounting.
• The Dean’s Award in Accounting/The Cohen & Co. Award.
• The Dean’s Award in Accounting/The Deloitte Award to an outstanding junior majoring in Accounting.
• The Dean’s Award in Accounting/The KPMG Award.
• The Dean’s Award in Accounting/The Meaden & Moore Award.
• The Dean’s Award in Accounting/The PwC Award.
• The Dean’s Award in Accounting/Skoda, Minotti & Company Award.
• The Department of Accountancy Academic Achievement Award.
• The Louis E. Levy Scholars in Accountancy for exceptional undergraduate accounting majors who will be entering professional graduate studies and demonstrate the ability to advance to the accounting profession and provide leadership for future generations of accountants.

Mortar Board

Mortar Board is a national honor society that recognizes full-time senior students for outstanding scholarship, leadership, and service.

Fellowships and Scholarships

Outstanding students may obtain information about national competitive fellowships and scholarships (Goldwater, Truman, Rhodes, etc.) in the Office of Undergraduate Studies, 357 Sears Building.

Departmental and Collegiate Awards

At academic awards assemblies at the end of each spring semester, the University recognizes the outstanding achievements of individual students. Departmental awards are based on achievement in specific academic disciplines. Some departmental and collegiate awards are based on a combination of leadership, scholarship, and service. The collegiate awards for students with the best academic records take into account credit load and grades; students who opt for the Pass/No Pass grading option in a course will not be eligible for best academic record awards unless the original evaluative grades submitted by the instructor to the Registrar’s Office would qualify them.

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• The Marvin J. Shamis Award.
• The Northeast Ohio Chapter of the Institute of Internal Auditors Scholarship.
• The Ohio Society of Certified Public Accountants Cleveland Endowment Scholarship.
• The Saltz, Shamis & Goldfarb/SS&G Scholarship Award.
• The Thomas Dickerson Award for Excellence in Professional Accountancy Studies to a student whose high academic achievement and leadership in the integrated studies program in accountancy is recognized as exemplary.
• The Wallach-Lee Families Scholarship Award.
• The Weatherhead School of Management Award to the most outstanding senior in accounting.

Anthropology

• The Callender Memorial Award for outstanding achievement in anthropology.
• The James Dysart Magee Award for the senior year to an outstanding student in social and behavioral sciences.
• The Jonathan F. Plimpton Award to a graduating senior for outstanding achievement in anthropology.
• The Ruth and Newbell Niles Puckett Award to a graduating senior for outstanding achievement in anthropology.

Art History

• The Friends of Art Prize to an undergraduate senior art history major for distinction in the field of art history.
• The Muriel S. Butkin Art History Prize for overall best performance and highest grade point average by an undergraduate art history major.
• The Noah L. Butkin Award for the best term paper on an art history topic written by an undergraduate.

Art Studio

• The Arnold Philip Award for excellence in art.
• The Charles E. Clemens Prize for outstanding talent and accomplishment in art.
• The Doris Young Hartsock Prize for excellence in art education.
• The Hazel Gibbs Herbruck Prize for excellence in art education.
• The William Grauer Award for excellence in art studio courses.

Astronomy

• The Jason J. Nassau Prize to an outstanding senior student in astronomy.

Biochemistry

• The Harland G. Wood Prize for outstanding performance by a graduating senior who is a candidate for the Bachelor of Science in Biochemistry.
• The Merton F. Utter Prize to a candidate for the Bachelor of Arts with a major in biochemistry.

Biology

• The Daniel Burke Prize for excellence in both biology and chemistry.
• The Flora Stone Mather Alumnae Award in Biology for outstanding scholarship, leadership, and service.
• The Daniel Burke Prize for excellence in both biology and chemistry.
• The Merton F. Utter Prize to a candidate for the Bachelor of Arts with a major in biochemistry.

• The Weatherhead School of Management Award to the most outstanding senior in accounting.
• The Francis Hobart Herrick Prize for outstanding biological research and academic excellence in biology
• The J. Paul Visscher Memorial Award of the Cleveland Audubon Society to the senior or graduate student who demonstrates outstanding ability and promise in the field of ecology or environmental science
• The Michelson-Morley Undergraduate Research Prize for outstanding research presentation, funded by the Howard Hughes Medical Institute
• The Ralph A. Spengler, Jr. Award for excellence in plant science
• The Russell M. Lawall Prize in Biological Sciences for excellence in biology

**Biomedical Engineering**

• The Biomedical Engineering Chairman’s Award for outstanding academic achievement and service to the biomedical engineering community
• The Biomedical Engineering Faculty Award for outstanding academic achievement, and service to the biomedical engineering community
• The Biomedical Engineering Research and Engineering Award for outstanding performance in biomedical engineering research combined with outstanding academic achievement
• The Biomedical Engineering Scholarship Award
• The Biomedical Engineering Teaching Assistant Award
• The Cristina A. Camardo Award to a biomedical engineering student in recognition of his or her leadership and service within the university community
• The Gheorghe and Claudia Mateescu Award for Research in Imaging for outstanding research contribution in the area of biomedical imaging
• The J. Thomas Mortimer Cooperative Education Award
• The Jose Ricardo Alcala Memorial Award for biomedical engineering research
• The Mark Bernstein Memorial Award to a senior biomedical engineering major for outstanding achievement in academics and leadership, contributions to research, and service to the university, department or community
• The Outstanding Biomedical Research Award
• The Outstanding Industrial Experience Award
• The Outstanding Senior Project Award
• The Srinivasa (Vasu) P. Gutti Chairman’s Award to an outstanding student in biomedical engineering

**Chemical and Biomolecular Engineering**

• The A. W. Smith Prize to a senior for academic achievement in chemical engineering in the junior and senior years
• The Carl F. Prutton Chemical Engineering Award to the senior whose academic performance merits his or her selection as outstanding.
• The Chemical Engineering Award for the outstanding junior student
• The Chemical Engineering Award for the outstanding sophomore student
• The Connie Ilcin Award to the student who exhibits outstanding performance in chemical engineering
• The Monroe J. Bahnson Award to a senior for achievement in chemical engineering whose work in design and research projects has been outstanding.
• The William H. Schuette Memorial Award to an outstanding senior in chemical engineering

**Chemistry**

• The ACS Organic Chemistry Award
• The Analytical Chemistry Award for excellence in analytical chemistry
• The Carl F. Prutton Prize for scholarship in chemistry to a student pursuing the Bachelor of Science degree
• The Charles F. Mabery Prize is awarded to the undergraduate or graduate student presenting the best thesis on a subject connected with research in the Department of Chemistry
• The Eli Lilly Award to a sophomore or junior chemistry major pursuing the BS degree
• The George A. Olah Award to an outstanding senior pursuing graduate work in chemistry
• The Hippolyte Gruener Award to a student for merit in chemistry
• The Ignacio Ocasio Freshman Chemistry Achievement Award for the highest achievement in freshman chemistry
• The Inorganic Chemistry Award for excellence in inorganic chemistry
• The Iota Sigma Pi/Frank Hovorka Prize to the woman chemistry major with the highest average after three semesters
• The Mateescu Citizenship Award
• The Merck Index Award to an outstanding organic chemistry student
• The Olin Freeman Tower Prize for excellence in physical chemistry
• Polymer Valley Chemical Undergraduate Research Award
• The W. R. Veazey Prize to a student with the highest academic achievement in physical chemistry courses

**Civil Engineering**

• The Allison C. Neff Memorial Award in recognition of high proficiency in professional studies and participation in professional activities to a member of the junior class majoring in civil engineering
• The Craig J. Miller Memorial Award to an undergraduate or graduate in the general field of civil engineering
• The Kenneth M. Haber Award to the outstanding student in civil engineering
• The Richard and Opal Vanderhoof Award to an outstanding senior in civil engineering
• The Roy Harley Prize to a promising senior or graduate student in civil engineering

**Classics**

• The Abraham Lincoln Fuller Prizes for excellence in the study of Greek or Latin
• The Emma Maud Perkins Prize for excellence in classical studies
• The Florence Appelbaum Greenbaum Scholarship for students studying Classics
• The Kathleen S. and Frederick C. Crawford Scholarship to the American School of Classical Studies in Athens

**Cognitive Science**

• The Award in Cognition and Culture
• The Cognitive Science Award to the graduating senior for outstanding academic achievement in cognitive science

**Dance**

• The Bradford W. Petot Award for Excellence in Dance to a student minoring in dance
• The Lily Dreyfuss Memorial Award for excellence in dance

Earth, Environmental and Planetary Sciences
• The Carol W. Walker Award for an outstanding senior project in the Department of Geological Sciences
• The Charles S. Bacon Award for outstanding contributions to the department
• The Philip O. Banks Award for outstanding academic achievement in geological sciences

Economics
• The Best Paper in Econometrics Award
• The Economics Department Achievement Award for excellence in scholarship and leadership in economics
• The Gardiner Scholarship to a junior majoring in economics and also interested in finance
• The Howard T. McMyler Award to an outstanding junior majoring in economics
• The H. W. Kniesner Prize to an outstanding senior in economics
• The James Dysart Magee Award to an outstanding student in economics for the senior year
• The Marvin J. Barloon Award for outstanding performance in economics
• The Robert N. Baird Award for academic excellence and leadership in extracurricular activities
• The Weatherhead School of Management Dean’s Achievement Award for scholarship and leadership in economics

Electrical Engineering and Computer Science
• The ACM Award to the senior judged by the student chapter of the Association for Computing Machinery most likely to have an outstanding professional career
• The Andrew R. Jennings Award for excellence in computer engineering and science
• The Best Senior Project Award
• The Chairman’s Award to a student in the Department of Electrical Engineering and Computer Science who shows exceptional academic or leadership potential
• The Donald P. Eckman Award to the outstanding senior in systems and control engineering
• The Electrical Engineering and Computer Science Award for the best senior project in computer science
• The Electrical Engineering and Computer Science Award for the best senior project in electrical and computer engineering
• The Electrical Engineering and Computer Science Research Award to the senior demonstrating exceptional research potential
• The Electrical Engineering Service Award to the student performing outstanding service to his or her class
• The IEEE/HKN Award to the senior judged by the student chapters of the Institute of Electrical and Electronics Engineers and Eta Kappa Nu to possess the qualities necessary for an outstanding professional career in a general field of electrical engineering
• The National Electrical Engineering Consortium William L. Everitt Award to a student who has excelled academically in communications or computers
• The Senior Project Award in Systems and Control Engineering
• The Undergraduate Alumni Capital Award in Systems and Control Engineering to a senior for academic excellence and professional promise.
• The W. Bruce Johnson Award to a senior for an outstanding project in the area of electrical sciences and applied physics

English
• The Charles E. Clemens Award for talent and accomplishment in writing
• The Edith Garber Krotinger Prize for excellence in creative writing
• The Eleanor Leuser Award for outstanding writing for or about children by a student enrolled in a creative writing course at the university
• The Emily M. Hills Award for the best poem or essay written by a woman in the College of Arts and Sciences
• The Finley Foster/Emily M. Hills Poetry Prize for the best poem or group of poems
• The Harriet Pelton Perkins Prize to an outstanding student majoring in English
• The Helen B. Sharnoff Award for formal poetry submitted by undergraduate students
• The Holden Prize for the best English paper written by an upper-class student
• The Karl Lemmerman Prize for the best paper by a first-year student
• The Nemet Scholarship for demonstration of excellence in creative writing

Environmental Studies
• The Henry David Thoreau Award for an outstanding senior in environmental studies

History
• The Annie Spencer Cutter Prize to a senior for outstanding achievement in history
• The Clarence H. Cramer Award for excellence in research and writing of history
• The Donald Grove Barnes Award to a senior for excellence in history
• The History Department Award for outstanding achievement in history
• The John Hall Stewart Prize for excellence in historical studies
• The Sigma Psi Prize for excellence in history

Judaic Studies
• The Eudese and Elmer Paull Prize for one or several undergraduate or graduate students who demonstrate an interest in Jewish studies or Jewish contemporary life
• The Ira and Ruth Bressler Prize to a student who has done outstanding work in the area of Jewish studies

Macromolecular Science and Engineering
• The Hal Loranger Award for Polymer Science to the outstanding senior in polymer science
• The Macromolecular Senior Achievement Award
• The Macromolecular Senior Leadership Award
• The Samuel Maron Memorial Award to an undergraduate for excellence in polymer research

Management
• The Excellence in Finance Award
• The Excellence in Marketing Award
• The Financial Executives Institute Award
• The Iris Wolstein Award for Excellence in Business Venture History to a student whose work on projects and/or course work related to the study of Cleveland business venture history is determined to have made a significant contribution to the understanding of the business development in Northeast Ohio and related environs
• The Kevin J. Semelsberger Prize for excellence in management
• The Nellie Chittenden Carlton Prize to a senior in management whose outstanding work in the general field of economics shows the greater promise of leadership
• The Outstanding Finance Student Award
• The Outstanding Marketing Student Award
• The Robert O. Berger Jr. Award to a junior who demonstrates overall achievement in scholarship, as well as notable community participation and leadership
• The Roulston Performance Award for outstanding performance in management
• The Wolstein Family Award for Excellence in Business Venture Plan Development to a student enrolled in a major or minor in Weatherhead undergraduate programs whose business venture development plan is considered to have the highest promise to be successfully initiated

Materials Science and Engineering
• The Professor Jack F. Wallace Award to the materials science and engineering student who embodies the dedication and spirit of Professor Wallace
• The Wesley P. Sykes Prize to a senior majoring in materials science and engineering who shows outstanding ability in scientific research, especially as evidenced by the quality of his or her senior project.

Mathematics, Applied Mathematics, and Statistics
• The Chair’s Award to a student contributing to the intellectual life of the majors’ program
• The Max Morris Prize for excellence in mathematics to a student pursuing the Bachelor of Science
• The Webster Godman Simon Mathematics Award to a student pursuing a Bachelor of Arts degree, for excellence in mathematics

Mechanical and Aerospace Engineering
• The Anish Shah ’91 Award to an outstanding senior in mechanical and aerospace engineering based on academic achievement, extracurricular activities, and community service
• The Fred Hale Vose Prize to the student in mechanical engineering who has demonstrated the greatest promise for professional leadership
• The Gustav Kuerti Award to the senior in mechanical and aerospace engineering who has demonstrated the highest level of scholarship
• The Robert and Leona Garwin Prize to a student who has demonstrated theoretical scientific ability with experimental competence and inventive talent

Modern Languages and Literatures
• The Arabic Book Prize for high achievement in Arabic
• The Chinese Book Prize for high achievement in Chinese
• The Department of Modern Languages and Literatures Award for outstanding achievement
• The Emile B. DeSauze Award for attaining the highest honors in modern languages and literatures
• The Florence Keuerleber Prize to an undergraduate student who has seriously pursued and excelled in the study of a modern language while majoring in another area
• The Folberth German Prize for excellence in German language and literature
• The French Book Prize for high achievement in French
• The German Book Prize for high achievement in German
• The Hebrew Book Prize for high achievement in Hebrew
• The Italian Book Prize for high achievement in Italian
• The Japanese Book Prize high achievement in Japanese
• The Louise Burke French Prize to an outstanding French student
• The Max Kade Excellence in German Award
• The Russian Book Prize for high achievement in Russian
• The Spanish Book Prize for high achievement in Spanish
• The Susie Scott Christopher Prize for excellent contributions to the French program

Music
• The Arthur H. Benade Prize to a senior with a major other than music who has made a notable contribution to music on campus during his or her undergraduate years
• The Charles E. Clemens Prize for talent and accomplishment in music
• The Doris Young Hartsock Prize for outstanding performance in music education
• The Lynman Piano Award
• The Ronis Recital Prize to an outstanding undergraduate majoring in music who has made an exceptional contribution to the musical life of the University and has been selected by audition to perform in the Leonard and Joan Ronis Annual Memorial Recital

Nursing
• The Bolton Scholar Award for Excellence in Acute Care Nursing
• The Bolton Scholar Award for Excellence in Community Health Nursing
• The Bolton Scholar Award for Excellence in Critical Care Nursing
• The Bolton Scholar Award for Excellence in Gerontology
• The Bolton Scholar Award for Excellence in Leadership and Community Service
• The Bolton Scholar Award for Excellence in Maternal-Child Nursing
• The Bolton Scholar Award for Excellence in Nursing Informatics
• The Bolton Scholar Award for Excellence in Nursing Research
• The Bolton Scholar Award for Excellence in Pediatric Nursing
• The Bolton Scholar Award for Excellence in Psychiatric/Mental Health Nursing
• The Dean’s Award for an outstanding capstone project
• The Director’s Award for the Outstanding Frances Payne Bolton School of Nursing Graduate

Nutrition
• The Mary Eliza Parker Award for excellence in nutrition and dietetics

Philosophy
• The Truman P. Handy Philosophical Prize to an outstanding junior and senior for excellence in philosophy
Physical Education
- The Arthur P. Leary Award to the outstanding freshman, sophomore, or junior who has demonstrated leadership, good sportsmanship, maintained good academic standing, and made contributions to the department of physical education and the university
- The Bill Sudeck Outstanding Student-Athlete Award to the student-athlete who has demonstrated and achieved significant athletic accomplishment, academic achievement, and engagement in campus activities, and has shown leadership in athletics and in the classroom
- The Dorothy L. Hoza Award to the outstanding freshman, sophomore, or junior who has made a strong contribution to the women's intercollegiate sports program, maintained a high level of academic achievement, shown leadership in the team, and contributed service to the department and university
- The Emily Russell Andrews Award to the senior woman who makes the greatest contribution to the physical education department through scholarship, leadership, participation, and service
- The Patricia B. Kilpatrick Award to the four-year varsity participant with the highest grade point average
- The Philip K. "Nip" Heim Award to the senior man who makes the most outstanding contribution to Case Western Reserve University through the athletic program

Physics
- The Albert A. Michelson Prize awarded upon completion of the junior year to a physics major who has demonstrated superior performance
- The Donald A. Glaser Award to an outstanding mathematics and physics student
- The Donald E. Schuele Award for an outstanding junior majoring in Engineering
- The Elmer C. Stewart Memorial Award to an outstanding senior in Engineering Physics
- The Leslie L. Foldy Award to the outstanding senior in physics
- The Polypark Kusch Prize to an outstanding senior in physics for the best thesis
- The Senior Award for service and scholarship in physics

Political Science
- The Flora Stone Mather Alumnae Award for outstanding academic performance in political science
- The James Dysart Magee Award for the senior year, to an outstanding student in social and behavioral sciences

Psychological Sciences
- The Flora Stone Mather Alumnae Award for outstanding academic performance in psychology
- The James Dysart Magee Award for the senior year, to an outstanding student in social and behavioral sciences
- The National Student Speech-Language-Hearing Association Award for outstanding leadership and achievement in communication sciences
- The Professor Edwin P. Hollander, Adelbert 1948, and Mrs. Patricia A. Hollander Capstone Research Award
- The Stephen Bednarik Memorial Award to an outstanding senior majoring in psychology

Religious Studies
- The Ratner Family Prize to a graduating senior for the highest academic achievement in the study of religion

Sociology
- The James Dysart Magee Award for the senior year, to an outstanding student in social and behavioral sciences
- The Mark Lefton Award for excellence in sociological studies
- The Robert C. Davis Award for demonstrated commitment to sociological studies
- The Schermerhorn Award for an outstanding student in sociology
- The Stella Berkeley-Friedman Award to a graduating senior for the highest academic achievement in the study of sociology

Theater
- The Barclay Leathem/Nadine Miles Award for creativity and general excellence in theater
- The Dionysus Award for an outstanding contribution to theater for a student not majoring in theater arts

Women's and Gender Studies
- The George Sand Award in Women's and Gender Studies to a graduating senior majoring or minoring in the field for excellence in academic performance
- The Mary Wollstonecraft Award to a continuing undergraduate student for excellence in Women's and Gender Studies courses
- The Sojourner Truth Award to an outstanding student who combines academic excellence in Women's and Gender Studies with commitment to community service, advocacy of women's and gender-related issues, and activism

Awards for Study Abroad
- The Alice Seagraves Award to outstanding students for study abroad
- The Brookes Friebelin Award to an outstanding student for study in France
- The Eva L. Pancoast Memorial Fellowship for graduating senior women in the College of Arts and Sciences or women students in the School of Graduate Studies interested in extending their education by foreign travel or study

Collegiate Awards
- The Alexandra Piepho Learning and Life Scholarship to the student who demonstrates enthusiasm for experiential learning and life, provides guidance to others, and exhibits a broad scope of learning interests
- The Army ROTC Professor of Military Science Award to the senior ROTC cadet who possesses the highest ideals of leadership, academics, and physical fitness
- The Baker-Nord Center for the Humanities Prize for excellence in a SAGES capstone project or senior paper in the humanities
- The Bolton Scholar Award for Academic Excellence
- The Bolton Scholar Award for Outstanding Capstone Project
- The Carol and Edward Breznyak '64 Cooperative Education Student of the Year Award to a student in the Case School of Engineering who has demonstrated outstanding performance in the Cooperative Education Program based on industry evaluations, written reports and student initiative
- The Case Alumni Association Prize for Achievement to the senior with the best academic record in the Case School of Engineering
- The Director's Award for Outstanding Bolton School of Nursing Graduate
- The Edward J. “Ted” Corcoran Award to a senior for outstanding leadership, character and service
• The Flora Stone Mather Alumnae Award for outstanding academic performance in the humanities
• The George T. Hunt Awards to a junior and a senior outstanding in leadership, scholarship, and service
• The Harriet Levion Pullman Award to a sophomore outstanding in scholarship, leadership, and service
• The John L. Fuller to the most outstanding graduating senior of the Case School of Engineering who has served the Case Engineer’s Council and the Case Alumni Association
• The John Schoff Mills Award to the senior with the best academic record in the College of Arts and Sciences
• The Joseph Skigin Memorial Award to an outstanding premedical student for the senior year
• The Louis K. Levy Prize for an outstanding junior in the College of Arts and Sciences
• The Matthew Leskiewicz Award to a senior in the Weatherhead School of Management for outstanding leadership and service
• The Outstanding Junior Awards of the Case School of Engineering to juniors with the best academic records at the end of five semesters in the Case School of Engineering
• The Outstanding Junior Awards of the College of Arts and Sciences to juniors with the best academic records at the end of five semesters
• The Outstanding Sophomore Awards of the Case School of Engineering to the sophomores with the best academic record at the end of three semesters in the Case School of Engineering
• The P. G. “Jerry” Lind Award for a graduating senior in engineering or science who has made a significant contribution to campus life
• The Peter Witt Scholarship to a deserving student who demonstrates a vital and active interest in the improvement of life in Cleveland
• The Phi Beta Kappa Prize for an outstanding junior in the College of Arts and Sciences
• The Sylvia Green Rosenberg Award to a part-time or full-time non-campus life, scholarship and community service
• The Stephanie Tubbs-Jones Award for significant contributions to campus life, scholarship and community service
• The Sylvia Green Rosenberg Award to a part-time or full-time non-traditional student
• The Weatherhead School of Management Award to a senior, for outstanding achievement in the Weatherhead School of Management
• The Weatherhead School of Management Dean’s Achievement Award for excellence in scholarship and leadership
• The Weatherhead School of Management Dean’s Achievement Award for excellence in scholarship and leadership in accounting/management

Undergraduate Non-Degree Students

Opportunities exist for individuals who are not seeking a degree from Case Western Reserve University to enroll in undergraduate courses for credit or to audit courses and not receive degree credit.

Enrolling in Courses for Credit

Cross-Registration in Northeast Ohio

Full-time undergraduates in good academic standing at the Cleveland Institute of Art, Cleveland State University, Cuyahoga Community College, or John Carroll University may cross-register for one course per semester at Case Western Reserve University during the fall or spring semester at no tuition cost. Cross-registration from other local colleges and universities will be considered on a case-by-case basis. Students wishing to participate in the cross-registration program should review the procedures at their home institutions. Registration at Case Western Reserve University is handled by the Office of Undergraduate Studies, and is normally limited to courses that are not offered at the student’s home institution. Cross-registered students must meet all prerequisite requirements before being admitted to specific courses.

Transient Students

A transient student is one who has begun his or her education at another college or university and intends to return there. Case Western Reserve University permits full- or part-time study as a transient student during the fall and spring semesters or during the summer session. Enrollment must be for credit-bearing courses.

Applications for enrollment as a transient student may be obtained from the Office of Undergraduate Studies. (International exchange students apply through the Office of International Affairs.) As part of the application, the student must present a statement of good standing from the registrar or dean of his or her home college or university that also indicates that the student is eligible to enroll for that semester at his or her home institution. Exceptions may be granted by appeal to the Academic Standing Board, c/o the Office of Undergraduate Studies.

Enrollment is limited to a total of 30 credit-hours and is subject to the regulations of the student’s college. Transient students must meet all prerequisite requirements before being admitted to specific courses. Transient students are expected to perform at the same academic standards as degree candidates. In particular, transient students whose records would make them eligible for separation as a degree candidate at Case Western Reserve University may not continue as transient students unless they successfully petition the Academic Standing Board.

Transient students are not eligible to receive financial aid from Case Western Reserve University. If the student’s home institution has entered into a consortium agreement with Case Western Reserve University, the student should inquire of the home institution regarding eligibility to receive aid through the home institution.

Others Who Have Completed High School But Not an Undergraduate or Advanced Degree

Adults who do not already hold an undergraduate or advanced degree may apply through the Office of Undergraduate Studies to enroll for credit in courses for which their education or experience has qualified them, even though they are not pursuing a baccalaureate degree. Case Western Reserve University permits full- or part-time study as a non-degree student during the fall and spring semesters or during the summer session. Enrollment must be for credit-bearing courses. (Persons who
already hold undergraduate or advanced degrees and wish to continue their studies without actively pursuing an additional degree should apply to the School of Graduate Studies.)

Applicants are expected to provide a transcript from the most recent college or high school attended. They must meet all prerequisite requirements before being admitted to specific courses. Those who have been degree-seeking students at Case Western Reserve University or have been denied admission to Case Western Reserve as an undergraduate transfer student are not eligible to attend as non-degree undergraduates.

Non-degree students are required to perform up to the same academic standards as degree candidates. In particular, non-degree students whose records would make them eligible for separation as a degree candidate at Case Western Reserve University may not continue as transient students unless they successfully petition the Academic Standing Board.

A non-degree student who wishes to become a degree candidate must apply through the Office of Undergraduate Admission. Courses taken for credit as a non-degree student may be applied toward the degree upon acceptance as a degree candidate.

Pre-College Scholars
The Pre-College Scholars Program (http://case.edu/ugstudies/pre-college-scholars-program) at Case Western Reserve University is designed to give highly motivated and able secondary school students the opportunity to enroll in challenging college courses prior to graduation from high school, either in the summer or during the academic year. Admission to the Pre-College Scholars Program is selective and competitive. Students must have pursued a rigorous curriculum and achieved academic excellence in all course work. Additional factors considered in admission are the applicant’s standardized test scores (ACT, PSAT, SAT, or other tests of aptitude and/or academic achievement), and the applicant’s academic goals and level of maturity. Pre-College Scholars may take a maximum of two courses per term. They attend regularly-scheduled classes with undergraduate students at Case Western Reserve, and must be able to work well independently at the college level. Questions about the program should be directed to the Office of Undergraduate Studies.

Auditing Courses
Special Audit
The Special Audit Program provides the adult student with the opportunity to attend a regular university course as a serious but informal observer at half the regular tuition. This program is available only to those not enrolled in a degree program at Case Western Reserve University. Special audit students receive no grades and no academic credit for the courses attended. No transcripts will be issued, but a certificate of attendance will be provided if requested. The Office of Undergraduate Studies handles registration for this program. No transcripts are necessary to register.

Course Audit Program for Senior Citizens
Case Western Reserve University’s Course Audit Program for Senior Citizens (http://www.case.edu/provost/seniorauditprogram) (CAPSC) allows senior citizens (age 65 and older) to take on campus courses at a reduced tuition rate. Additional information is available from the CAPSC Coordinator (lifelonglearning@case.edu).

College of Arts and Sciences Alumni Audit
Case Western Reserve University alumni under the age of 65 may audit courses offered by the College of Arts and Sciences for 10% of regular tuition. Most, but not all, courses are available for audit. Additional information is available on the College of Arts and Sciences Alumni Audit web site (http://artsci.case.edu/alumni-audit).
PHYSICAL EDUCATION & ATHLETICS

Veale Center
http://athletics.case.edu/landing/index
Amy Backus, Director of Athletics and Chair, Physical Education and Athletics
amy.backus@case.edu

The Department of Physical Education and Athletics (http://studentaffairs.case.edu/athletics/default.html) offers the student a variety of opportunities from challenging academic classes to vigorous recreational activities.

Case Western Reserve University sponsors 19 NCAA Division III varsity sports. Men’s sports include football, soccer, cross country, basketball, wrestling, swimming, baseball, tennis and indoor/outdoor track & field. Women’s sports include volleyball, basketball, swimming, indoor/outdoor track & field, tennis, cross country, soccer and softball.

CWRU is a charter member of the University Athletic Association (UAA), sharing in the belief that academic excellence and athletic excellence are not mutually exclusive. The Spartans are joined in the UAA by Brandeis University, Carnegie Mellon University, Emory University, New York University, University of Chicago, University of Rochester and Washington University in St. Louis.

The Spartan football team also maintains affiliate membership in the Presidents’ Athletic Conference (PAC).

The department sponsors a variety of intramural and club sport activities, including archery, cheerleading, crew, cycling, fencing, ice hockey, lacrosse, kendo, kung fu, table tennis, tae kwon do, ultimate frisbee, volleyball, and water polo. Sport clubs are available to all students, faculty, and staff. Intramural competition is available in more than 40 activities, and more than one-half of undergraduates participate for relaxation, physical fitness, and a chance to improve skills.

Lifetime Sports Program

The department has designed an instructional program of modern activities and lifetime sports. Each semester, fifteen to twenty-five co-educational lifetime sports classes are offered.

Undergraduates have a one-year physical education requirement to be completed in the first year. Required classes, for zero credits, are offered for either half-semester or full-semester. First year students have first priority in electing PHED 010-199. Others who have completed the requirement may audit classes.

A number of popular, advanced lifetime sports activities are also offered for one hour of academic credit. Advanced skills, strategy, and coaching are taught (PHED 200-299).

Recreational Activities and Intercollegiate Athletics

The intramural program provides a continuous schedule of activities throughout the year. Individual and team sports are available to students in several divisions: university housing, fraternity, women, coed, graduate, and open. Intercollegiate varsity athletic competition is available in ten sports for men and nine sports for women.

Reserve Officers Training Corp (Army ROTC)

An Army Reserve Officer Training Corp (ROTC) program is available to Case Western Reserve University students through a partnership agreement with the US Army and a cooperative arrangement with John Carroll University. Some of the first- and second-year ROTC classes are offered on the Case Western Reserve University campus through the department of Physical Education and Athletics. Participating students may be exempt from the undergraduate physical education requirement. For courses offered at Case Western Reserve (MLSC 101, MLSC 102, MLSC 201, and MLSC 202), students register in the ordinary way. For other Army ROTC classes, students enroll through cross-registration in the Department of Military Science at John Carroll University, which is approximately five miles from Case Western Reserve. For additional information on ROTC programs, see the Undergraduate Collaborative Programs (p. 1083) section of the Bulletin.

Sports Medicine Minor

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHED 332</td>
<td>Introduction to Sports Medicine</td>
<td>3</td>
</tr>
<tr>
<td>PHED 334</td>
<td>Orthopedic Assessment of the Upper Extremity</td>
<td>3</td>
</tr>
<tr>
<td>PHED 339</td>
<td>Orthopedic Assessment of the Lower Extremity</td>
<td>3</td>
</tr>
<tr>
<td>PHED 341</td>
<td>Physiology of Exercise</td>
<td>3</td>
</tr>
<tr>
<td>PHED 342</td>
<td>Kinesiology</td>
<td>3</td>
</tr>
<tr>
<td>PHED 350</td>
<td>Therapeutic Rehabilitation and Modalities</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Units: 18

Contact Jessica White (jessica.m.white2@case.edu), Head Athletic Trainer, for more information at Veale Center, 216.368.2863.

Department Faculty

Amy Backus, MEd
(Loyola University Chicago)
Professor
Director of Athletics & Chair, Department of Physical Education and Athletics

Brandon Bianco, BA
(Ohio Wesleyan University)
Instructor
Head Men's Soccer Coach

Shannel Blackshear, MA
(University of Arkansas)
Instructor
Assistant Softball Coach

Nick Callahan, BA
(SUNY Brockport)
Instructor
Assistant Baseball Coach

Jordan Carmosino, MS
(Indiana Wesleyan University)
Instructor
Assistant Athletic Trainer
Kassandra Corsi, MS, ATC
(University of Akron)
Instructor
Assistant Athletic Trainer

Tiffany Crooks, MBA
(Case Western Reserve University)
Assistant Professor
Head Women’s Soccer Coach

Greg Debeljak, MA
(John Carroll University)
Associate Professor
Head Football Coach

Alexandra Dellas, MA
(Kent State University)
Instructor
Assistant Women’s Basketball Coach

Matthew Engleander, BA
(The College of Wooster)
Instructor
Head Baseball Coach

Karen Farrell, MS
(University of Massachusetts at Amherst)
Associate Professor
Head Women’s Volleyball Coach; Associate Athletic Director; Senior Woman Administrator

Kirsten Gambrell, MBA
(Berry College)
Instructor
Head Women’s Tennis Coach

Josie Henry, MA
(Minnesota State University)
Assistant Professor
Head Fast Pitch Softball Coach

Patrick Kennedy, MS
(University of Maryland)
Professor
Associate Athletic Director & Intramural and Club Sports Director

Rudy Kirbus, MEd
(John Carroll University)
Instructor
Assistant Men’s Basketball Coach

Kathy Lanese, BS
(Ohio University)
Instructor
Head Women’s Cross Country Coach and Assistant Men’s Track and Field Coach

Ben Lolli, MA
(Walsh University)
Instructor
Assistant Football Coach

Todd McGuinness, BA
(Bethany College)
Instructor
Head Men’s Basketball Coach

Kristy Miller, MSSA
(Case Western Reserve University)
Instructor
Assistant Men’s & Women’s Swimming and Diving Coach

Warren Miller, BA
(Baldwin Wallace University)
Instructor
Defensive Coordinator, Football

Doug Milliken, MS
(Indiana State University)
Assistant Professor
Head Men’s and Women’s Swimming & Diving Coach

Brett Piper, MS, AT, PES
(California University of Pennsylvania)
Instructor
Assistant Athletic Trainer

Jennifer Reimer, MEd
(Bowling Green State University)
Assistant Professor
Head Women’s Basketball Coach

Eric Schmuhl, MEd
(Muskingum College)
Instructor
Head Men’s and Women’s Track Coach

Dereck Slesh, MBA
(Cleveland State University)
Associate Professor
Offensive Coordinator, Football

Daniel Song, BA
(University of Iowa)
Instructor
Head Wrestling Coach

Jessica White, MA
(Defiance College)
Assistant Professor
Head Athletic Trainer

Todd Wojtkowski, MBA
(The Citadel)
Assistant Professor
Head Men’s Tennis Coach

**MLSC Courses**

**MLSC 101. Leadership and Personal Development. 1 Unit.**
This course establishes a framework for understanding officership, leadership, and Army values. Also addresses personal development skills, including physical fitness and time management. Note: Enrollment in this course by a non-contracted student does not obligate the student to the military or the Army ROTC program.
MLSC 102. Introduction to Tactical Leadership. 1 Unit.
This course focuses on communications, leadership, and problem solving. Introduces students to the duties and responsibilities of an Army lieutenant as well as examining current pay and benefits. Note: Enrollment in this course by a non-contracted student does not obligate the student to the military or the Army ROTC program. Recommended preparation: MLSC 101.

MLSC 201. Innovative Team Leadership. 2 Units.
Use of ethics-based leadership skills to develop individual abilities and contribute to effective team-building. Focus on skills in oral presentations, writing concisely, planning of events, coordination of group efforts, advanced first aid, land navigation, and basic military tactics. Learn the fundamentals of ROTC's Leadership Development Program. Participation in a weekend field training exercise is optional but encouraged. Note: Enrollment in this course by a non-contracted student does not obligate the student to the military or the Army ROTC program. Recommended preparation: MLSC 101, 102.

MLSC 202. Foundations of Tactical Leadership. 2 Units.
Introduction to individual and team aspects of military tactics in small-unit operations. Includes use of radio communications, making safety assessments, movement techniques, planning for team safety/security, and methods of pre-execution checks. Practical exercises with upper-division ROTC students. Techniques for training others as an aspect of continued leadership development. Participation in a weekend exercise is optional but encouraged. Note: Enrollment in this course by a non-contracted student does not obligate the student to the military or the Army ROTC program. Recommended preparation: MLSC 101, 102, 201.

PHED Courses

PHED 10A. Cardio Games (First Half). 0 Unit.
Cardio Games emphasizes conditioning of the aerobic and anaerobic systems through fun and energetic games such as Ultimate Frisbee, Tag, Dodge Ball, Flicker Ball and more. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 10B. Cardio Games (Second Half). 0 Unit.
Cardio Games emphasizes conditioning of the aerobic and anaerobic systems through fun and energetic games such as Ultimate Frisbee, Tag, Dodge Ball, Flicker Ball and more. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 11A. Jump Rope Training (First Half). 0 Unit.
This class is designed to help students develop quickness, agility, balance, strength, power, and endurance through jump rope training. Students will learn rope-handling skills, jump techniques and training routines to help supplement training for fitness and performance. Workouts and progressions are included for warm-up, cool-down, fitness components and sport-specific training. Prereq: Undergraduate degree seeking student.

PHED 12A. Badminton (First Half). 0 Unit.
This class provides the student with the basic skills, footwork and strategies necessary to play the sport of badminton. Emphasis is placed on skill development through instruction and drills as well as singles and doubles match play. This class is appropriate for all students. Students with special needs can be accommodated. Prereq: Undergraduate degree seeking student.

PHED 12B. Badminton (Second Half). 0 Unit.
This class provides the student with the basic skills, footwork and strategies necessary to play the sport of badminton. Emphasis is placed on skill development through instruction and drills as well as singles and doubles match play. This class is appropriate for all students. Students with special needs can be accommodated. Prereq: Undergraduate degree seeking student.

PHED 13A. Rock Wall Climbing (First Half). 0 Unit.
This course is designed to give students a comprehensive introduction to the skills, safely, terminology and equipment used in the sport of recreational activity of rock climbing. Prereq: Undergraduate degree seeking student.

PHED 13B. Rock Wall Climbing (Second Half). 0 Unit.
This course is designed to give students a comprehensive introduction to the skills, safely, terminology and equipment used in the sport of recreational activity of rock climbing. Prereq: Undergraduate degree seeking student.

PHED 14B. Indoor Rowing (Second Half). 0 Unit.
This course introduces the student to basic indoor rowing techniques, skills, and equipment. Students will learn conditioning programs to prepare the student to continue in recreational, fitness or competitive rowing programs. Prereq: Undergraduate degree seeking student.

PHED 21A. Hatha Yoga (First Half). 0 Unit.
This course provides an introduction to Hatha Yoga, presenting body awareness, basic philosophy, breathwork, postures and meditation techniques. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 21B. Hatha Yoga (Second Half). 0 Unit.
This course provides an introduction to Hatha Yoga, presenting body awareness, basic philosophy, breathwork, postures and meditation techniques. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 22A. Intermediate Hatha Yoga (First Half). 0 Unit.
This course utilizes the basics of Hatha Yoga including body awareness, philosophy, breathwork, and postures with emphasis on increased strengthening, increased aerobic segments, and more challenging postures. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 22B. Intermediate Hatha Yoga (Second Half). 0 Unit.
This course utilizes the basics of Hatha Yoga including body awareness, philosophy, breathwork, and postures with emphasis on increased strengthening, increased aerobic segments, and more challenging postures. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 24B. Jogging (Second Half). 0 Unit.
Prereq: Undergraduate degree seeking student.

PHED 25A. Power Volleyball (First Half). 0 Unit.
This class introduces volleyball skills, techniques, strategies, rules and scoring. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 25B. Power Volleyball (Second Half). 0 Unit.
This class introduces volleyball skills, techniques, strategies, rules and scoring. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.
PHED 26A. Racquetball (First Half). 0 Unit.
This course teaches racquetball skills and strategies for team and individual play. Course content includes terminology, skill development, scoring, etiquette and safety. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 26B. Racquetball (Second Half). 0 Unit.
This course teaches racquetball skills and strategies for team and individual play. Course content includes terminology, skill development, scoring, etiquette and safety. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 27A. Indoor Group Cycling (First Half). 0 Unit.
A stationary cycling program set to motivational music. Students will learn how to use and set up the bike and how to create a challenging workout using sprints, jumps and climbs. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 27B. Indoor Group Cycling (Second Half). 0 Unit.
A stationary cycling program set to motivational music. Students will learn how to use and set up the bike and how to create a challenging workout using sprints, jumps and climbs. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 28A. Squash (First Half). 0 Unit.
Students will be introduced to the skills, techniques and strategies necessary to play the sport of squash. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 28B. Squash (Second Half). 0 Unit.
Students will be introduced to the skills, techniques and strategies necessary to play the sport of squash. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 29A. Swimming - Beginning and Intermediate (First Half). 0 Unit.
This course focuses on basic swimming skills and safety. This class is appropriate for non-swimmers to those students with mid-range swimming skills. Students with disabilities may be accommodated. Prereq: Undergraduate degree seeking student.

PHED 29B. Swimming - Beginning and Intermediate (Second Half). 0 Unit.
This class focuses on basic swimming skills and safety. This class is appropriate for non-swimmers to those students with mid-range swimming skills. Students with disabilities may be accommodated. Prereq: Undergraduate degree seeking student.

PHED 30A. Swimming - Endurance (First Half). 0 Unit.
This class is for individuals who have mastered intermediate swimming skills and wish to develop advanced swimming skills and greater swimming endurance. Prereq: Undergraduate degree seeking student.

PHED 30B. Swimming - Endurance (Second Half). 0 Unit.
This class is for individuals who have mastered intermediate swimming skills and wish to develop advanced swimming skills and greater swimming endurance. Prereq: Undergraduate degree seeking student.

PHED 31A. Tennis (First Half). 0 Unit.
Students will learn the tennis skills and strategies necessary for both singles and doubles play. Emphasis is placed on stroke development, rules, scoring and etiquette. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 31B. Tennis (Second Half). 0 Unit.
Students will learn the tennis skills and strategies necessary for both singles and doubles play. Emphasis is placed on stroke development, rules, scoring and etiquette. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 32A. Tennis (First Half). 0 Unit.
This course focuses on the tennis skills and strategies necessary for both singles and doubles play. Emphasis is placed on stroke development, rules, scoring and etiquette. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 32B. Tennis (Second Half). 0 Unit.
This course focuses on the tennis skills and strategies necessary for both singles and doubles play. Emphasis is placed on stroke development, rules, scoring and etiquette. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 34A. Weight Training (First Half). 0 Unit.
This class focuses on muscular strength and endurance training through individualized weight training programs. Emphasis is placed on appropriate use of equipment and safety procedures. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 34B. Weight Training (Second Half). 0 Unit.
This class focuses on muscular strength and endurance training through individualized weight training programs. Emphasis is placed on appropriate use of equipment and safety procedures. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 39A. Bowling (First Half). 0 Unit.
This class introduces bowling skills, techniques, strategies, rules and scoring. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 39B. Bowling (Second Half). 0 Unit.
This class introduces bowling skills, techniques, strategies, rules and scoring. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 40A. Basketball (First Half). 0 Unit.
This class introduces basketball skills, techniques, rules and basic offense and defense. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 40B. Basketball (Second Half). 0 Unit.
This class introduces basketball skills, techniques, rules and basic offense and defense. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 41A. Softball (First Half). 0 Unit.
This class introduces softball skills, techniques, rules and basic offense and defense strategies. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 42A. Indoor Soccer (First Half). 0 Unit.
This class introduces indoor soccer skills, techniques, rules and scoring. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 42B. Indoor Soccer (Second Half). 0 Unit.
This class introduces indoor soccer skills, techniques, rules and basic offense and defense. This class is appropriate for most students. Prereq: Undergraduate degree seeking student.

PHED 44A. Core Yoga (1st Half). 0 Unit.
This course combines Hatha Yoga poses, Pilates exercises, body awareness and breathwork while focusing on deep stabilizing abdominal muscles. Students will combine stretching and strengthening to improve posture and flexibility and create balance in the physical body. Students will learn slow, controlled movements to help tone and condition. Prereq: Undergraduate degree seeking student.

PHED 44B. Core Yoga (2nd Half). 0 Unit.
This course combines Hatha Yoga poses, Pilates exercises, body awareness and breathwork while focusing on deep stabilizing abdominal muscles. Students will combine stretching and strengthening to improve posture and flexibility and create balance in the physical body. Students will learn slow, controlled movements to help tone and condition. Prereq: Undergraduate degree seeking student.

PHED 45A. Introduction to Speed and Agility Training. 0 Unit.
This introductory course is intended for the student with an interest in training of speed and agility specific to their sport interest. The course will focus on the aspects of physical training necessary for the development of speed and agility and improved athletic performance. Prereq: Undergraduate degree seeking student.
PHED 45B. Introduction to Speed and Agility Training. 0 Unit.
This introductory course is intended for the student with an interest in training of speed and agility specific to their sport interest. The course will focus on the aspects of physical training necessary for the development of speed and agility and improved athletic performance. Prereq: Undergraduate degree seeking student.

PHED 50A. Personal Safety Awareness (First Half). 0 Unit.
This class focuses on safety and preventative techniques. Emphasis is placed on self-protection. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 50B. Personal Safety Awareness (Second Half). 0 Unit.
This class focuses on safety and preventative techniques. Emphasis is placed on self-protection. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 55A. Cardio-Fitness (First Half). 0 Unit.
This class presents the components of physical fitness through conditioning activities utilizing equipment such as stairclimbers, treadmills, and elliptical trainers. Students will evaluate their fitness levels and learn how to put together an individualized workout program. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 55B. Cardio-Fitness (Second Half). 0 Unit.
This class presents the components of physical fitness through conditioning activities utilizing equipment such as stairclimbers, treadmills, and elliptical trainers. Students will evaluate their fitness levels and learn how to put together an individualized workout program. This class is appropriate for all students. Prereq: Undergraduate degree seeking student.

PHED 60A. CPR/First Aid (1st half). 0 Unit.
Students will learn the basic first aid and CPR skills necessary to act in an emergency. Automated external defibrillation training is included. This class involves both lecture and hands-on work. Students will have the opportunity to achieve Basic Rescuer certification at the completion of the class.

PHED 60B. CPR/First Aid (2nd half). 0 Unit.
Students will learn the basic first aid and CPR skills necessary to act in an emergency. Automated external defibrillation training is included. This class involves both lecture and hands-on work. Students will have the opportunity to achieve Basic Rescuer certification at the completion of this class.

PHED 65A. Team Building, Leadership, and Creative Movement (2nd half). 0 Unit.
The primary purpose of this course is to provide an opportunity for Orientation leaders to: work as a team and build transferable skills for collaboration, active listening, communication, and motivation; learn dance movement as a form of communication and stress reduction; create the Orientation Leader Boogie Dance (performed at Welcome Days tradition and football game halftime show); understand the value in personal decision making and awareness (stress reduction, drug/alcohol awareness, sexual assault, etc.); learn campus resources; build Orientation Leader esprit de corps and enhance school spirit. This course will develop more effective and competent university ambassadors. In addition, the course will facilitate the development of leadership skills.

PHED 66A. Advanced Rowing (First Half). 0 Unit.
This course is designed to enhance the rowing technique of the experienced rower. Prereq: Undergraduate degree seeking student.

PHED 66B. Advanced Rowing (Second Half). 0 Unit.
This course is designed to enhance the rowing technique of the experienced rower. Prereq: Undergraduate degree seeking student.

PHED 100. Independent Activity. 0 - 10 Units.
This course is designed to allow the student to write individual fitness goals, compose an individual fitness program specific to the goals and execute the individual program. Students are required to participate in a pre- and post-testing program and must achieve a minimum of 75% for each test component (national norms) in order to participate in Independent Activity. The course instructor must approve all programs. The student will be required to maintain a detailed activity log.

PHED 108. Fencing. 0 Unit.
Fencing is the art of swordsmanship. Students will learn fencing skills such as on guard, lunge, attack, parry and touch. Students will learn the rules of competition and have the opportunity to compete during class time.

PHED 130. Wellness. 0 Unit.
This lecture class teaches the components of physical fitness as well as evaluation techniques, fitness assessment, body composition, nutrition and weight control information. This class is appropriate for all students.

PHED 131. Personal Fitness. 0 Unit.
Personal Fitness is a full semester class that teaches the components of physical fitness through both lecture and activity. Students will assess their fitness levels and learn conditioning activities to improve flexibility, cardiovascular endurance, muscular strength and endurance. Nutrition, weight control and concepts of wellness are covered in this class. This class is appropriate for most students.

PHED 141. Dance. 0 Unit.
This course is designed to introduce the student to dance. Students will be exposed to a variety of dances including contemporary, jazz, folk and formal dancing. Students will learn how choreography is mounted and how dancers remember it. The class is appropriate for beginners as well as students with dance experience.
PHED 170. Varsity Baseball. 0 Unit.
PHED 171. Varsity Basketball (Men). 0 Unit.
PHED 172. Varsity Basketball (Women). 0 Unit.
PHED 174. Varsity Cross Country (Men). 0 Unit.
PHED 175. Varsity Cross Country (Women). 0 Unit.
PHED 178. Varsity Football. 0 Unit.
PHED 180. Varsity Soccer (Men). 0 Unit.
PHED 181. Varsity Soccer (Women). 0 Unit.
PHED 182. Varsity Swimming (Men). 0 Unit.
PHED 183. Varsity Swimming (Women). 0 Unit.
PHED 184. Varsity Tennis (Men). 0 Unit.
PHED 185. Varsity Tennis (Women). 0 Unit.
PHED 186. Varsity Track and Field (Men). 0 Unit.
PHED 187. Varsity Track and Field (Women). 0 Unit.
PHED 188. Varsity Volleyball. 0 Unit.
PHED 189. Varsity Wrestling. 0 Unit.
PHED 190. Varsity Softball (Women). 0 Unit.

PHED 216. Weight Training II. 1 Unit.
This class is for the student with weight training experience and/or the student who has successfully completed the basic weight training program and wishes to continue training in an advanced program. Advanced skill development, program development and safety are emphasized. This class section does not satisfy the Physical Education requirement.

PHED 218. Wellness. 1 Unit.

PHED 325. Officiating Basketball. 2 Units.
Administrative procedures, promotion, managerial relationships, scheduling, tournaments, budgeting, scoring systems, and officiating.

PHED 331. Physiology of Exercise. 3 Units.
The classroom and laboratory experiences in this class are intended to provide an understanding of physiological adaptations of the human body to acute and chronic exercise. The classroom portion will focus mainly on the response and adaptation of bodily systems to exercise and the relationship of physiology to sport, health and exercise programs. The laboratory portion will focus on evaluation of the physiological response to exercise. Prereq: PHED 332, PHED 342, PHED 334, PHED 339.

PHED 342. Kinesiology. 3 Units.
The purpose of this course is to present the conceptual ideas and general principles of the science of human movement. It reviews and applies the pertinent aspects of anatomy, physiology and mechanics. Subject matter is drawn from research and clinical findings of widely dispersed kinesiological subdisciplines and professional specializations. Prereq: PHED 332.

PHED 350. Therapeutic Rehabilitation and Modalities. 3 Units.
Topics covered in this class include concepts and practices associated with the conditioning and reconditioning (rehabilitation) of athletic injuries. Principles and practical skills associated with therapeutic modalities used in the treatment and rehabilitation of athletic injuries are also covered. This class involves lectures, labs and clinical hours. Prereq: PHED 332, PHED 334, PHED 339, and PHED 342.
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